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MAGAZINE

FIRST LOOKS

Controversial Intel 486SX Chip Debuts In IBM's PS/2 Model 90 XP

COMPUTERS

High-End Computing Gets Cheaper: PC Labs Tests 29 486/25 PCs

HARDWARE

Reliable, Removable, Rewritable Storage: 17 Magneto-Optical Drive Subsystems

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Track Down Your PATH Problems with CHKPATH.COM

JUNE 11, 1991 THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOLUME 10 NUMBER 11

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Backup software protects your data from disaster.

PC Labs tests 11 fast, easy programs good enough for daily backup.

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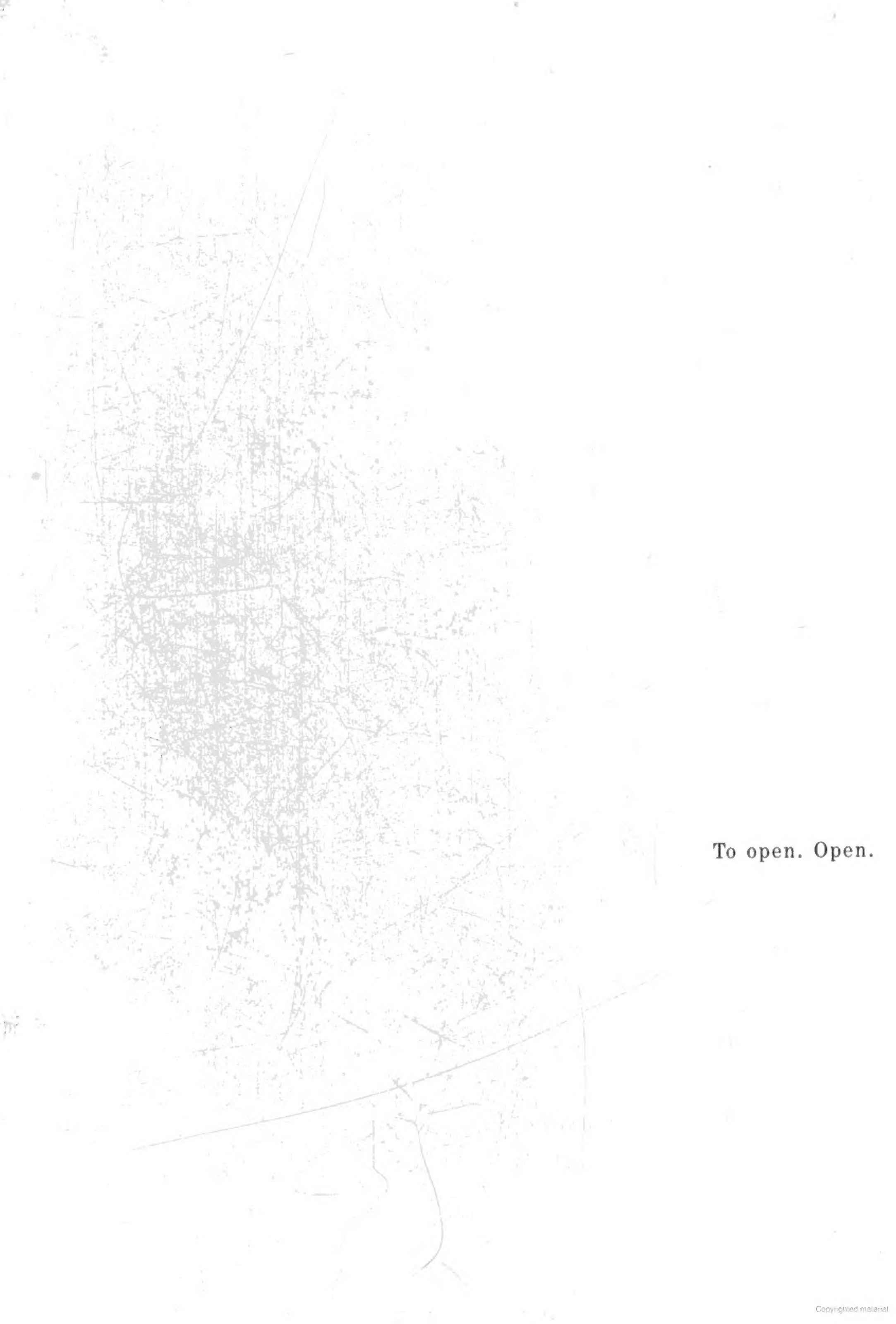

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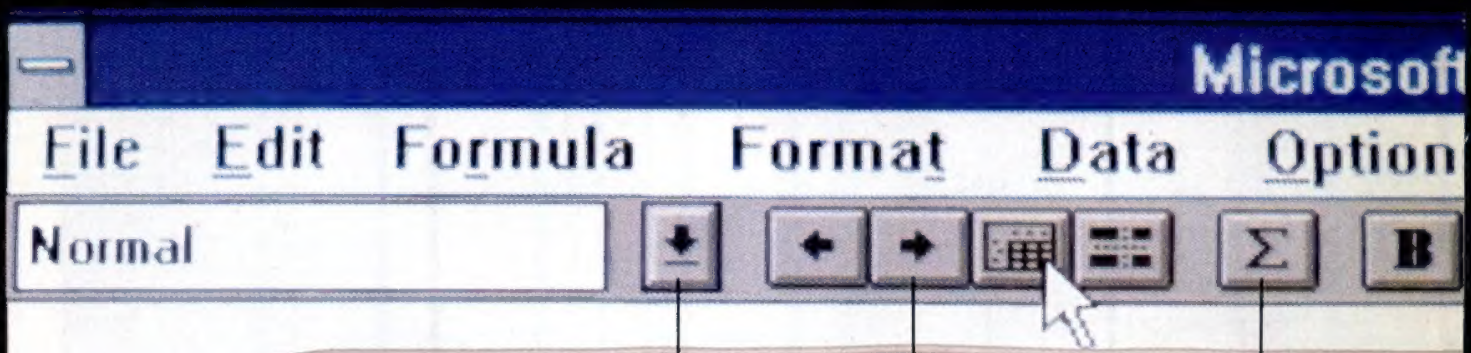

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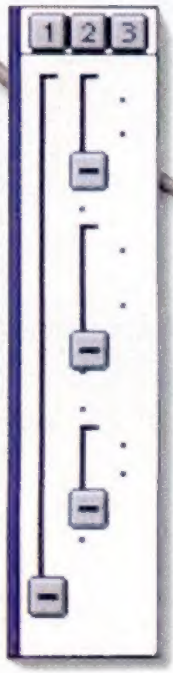

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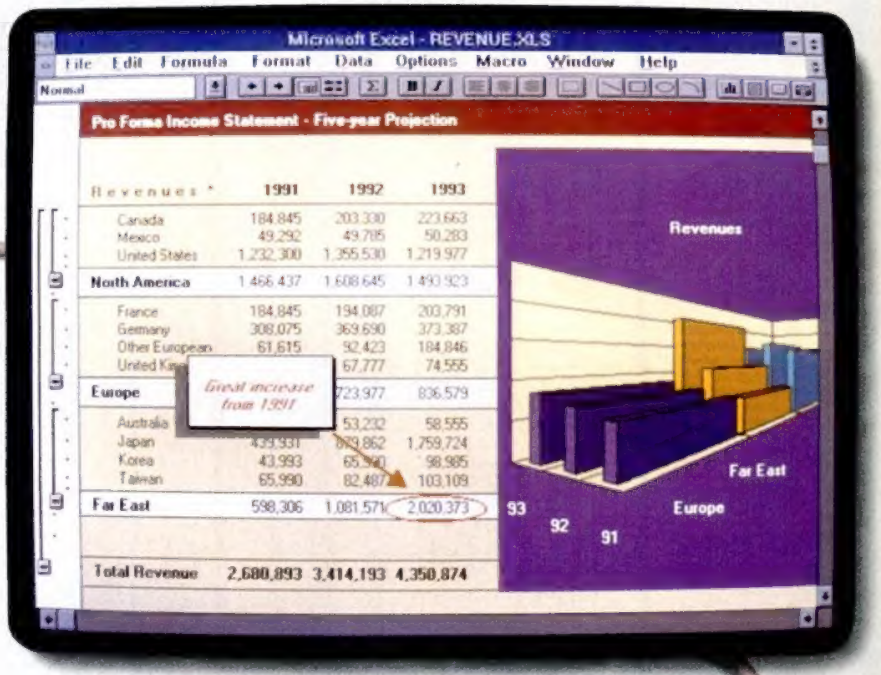

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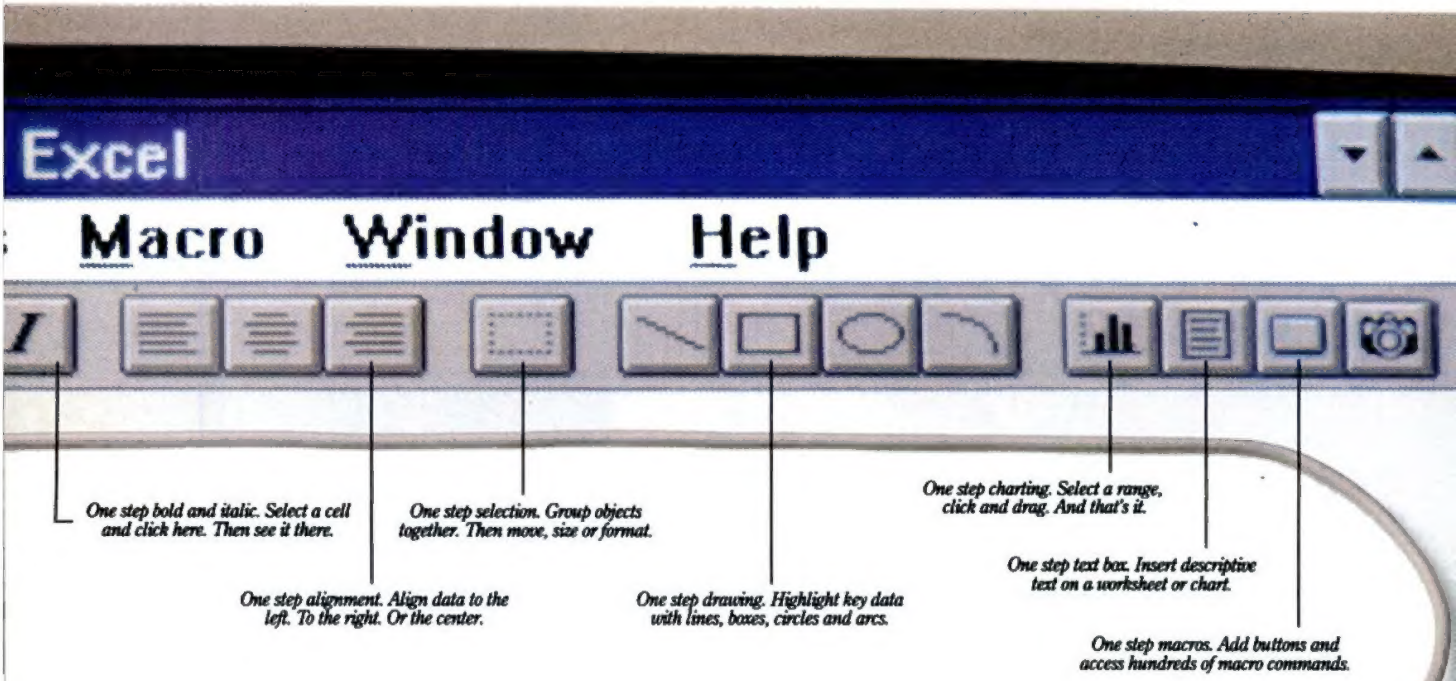
to make this spreadsheet do tely it'll only take you one.



Introducing Microsoft Excel version 3.0.

Out of all the steps it took us to create the new Microsoft® Excel for Windows™, there were two in particular that had the most impact. The first was to listen to our users and to listen carefully. The second was to take that knowledge and implement it intelligently.

The result is outrageous power coupled with ease-of-use. It is this idea that drives all of our efforts. And has since we introduced the first graphical spreadsheet back in 1985.

A recent example of this is the Toolbar™. This addition lets you do everything from formatting, to formulas, to outlining with one click of a button.

Best of all, it's really easy to make the move. Microsoft Excel comes with online help for 1-2-3® users. So you can learn by simply applying your existing knowledge.

Take the next step, call (800) 541-1261, Dept. Q13, for the name of a dealer near you.

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PC MAGAZINE
EDITORS' CHOICE
March 26, 1991
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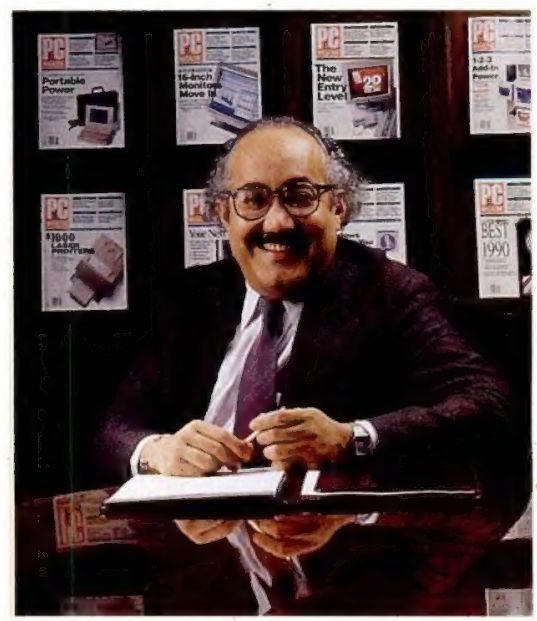
CIRCLE 210 ON READER SERVICE CARD

Inside

PC Magazine is too small. At least we think the staff is. It's too small to do the job of pumping out hundreds of pages of incredibly dense, technically rich material per issue, 22 times a year. Just as it outgrows and overflows your bookshelves, *PC Magazine* has outgrown and overflowed every metaphor for managing and directing its internal processes.

Enter Joel Dreyfuss. Fresh from an eight-year stint at *Fortune*, Dreyfuss takes on the newly created role of editor of *PC Magazine*, responsible for supervising day-to-day editorial operations. He brings a wealth of big-magazine experience with him, the kind of experience *PC Magazine* will need to manage its growth. But he's more than just a nationally recognized editor. He's been an avid *PC Magazine* reader for years. He cares deeply about the technology, the products, and how people use them.

Dreyfuss got his start with personal computers by helping a friend who bought one of the early pre-IBM machines, way back in 1980. The friend was stunned into inaction when he realized that he had to put the system together from a boxful of parts and a single sheet of photocopied instructions. Dreyfuss took on the job, trusting his intellectual curiosity and common sense to see him through. The machine worked fine. More recently, he's been investigating the state of the art in desktop publishing, and he also enjoys delving into the latest software and hardware.



New editor Joel Dreyfuss: Ready for his most challenging assignment—supervising day-to-day editorial operations.

You'll find another debut in this issue: a new way to present the benchmark test results for individual PCs in the first installment of our two-part comparison of 486 machines. Our high-low-average charts compare the performance of each machine to the fastest, slowest, and average performers in the four major performance categories. Each machine's strengths and weaknesses stand out clearly, as do the overall characteristics of the group. We think you'll like it.

You'll also like the cover story, which reviews backup software. The number of users who back up their disks regularly is depressingly small, making a good business for disaster recovery utilities. Once you see how comprehensive these programs are, backing up won't seem like such an onerous task.—**Bill Machrone** ■

PHOTOGRAPHY: THOM O'CONNOR

PC Magazine: The Independent Guide to Personal Computing, ISSN #0888-8507, is published biweekly except in July and August for $44.97 for one year. Ziff-Davis Publishing Co., a division of Ziff Communications Co., One Park Ave., New York, NY 10016. Second-class postage paid at New York, NY 10016 and at additional mailing offices. POSTMASTER: Address changes to *PC Magazine*, P.O. Box 54093, Boulder, CO 80321-4093.

Before You Blow $500 On Lotus 1-2-3, Excel Or Quattro Pro, Read This.

CA Shocks Spreadsheet World With 70% Price Cut: Highly-Rated SuperCalc5 Now Only $149.00

CAMBRIDGE, Mass — Early today Computer Associates announced a dramatic price reduction on one of the industry's most popular and best-selling spreadsheet programs, SuperCalc5.

Effective immediately, the suggested retail list price for SuperCalc5 has been slashed from $495.00 to $149.00. This means that the new street price for SuperCalc5 — which is Lotus 1-2-3 compatible — will very likely be under $100.00.

This bold, new pricing strategy is great news for spreadsheet users. It means now everyone can afford to trade up to the most advanced spreadsheet technology in the industry. And unlike Lotus 1-2-3 3.0 or Excel

"We've always listened closely to what users want and they've been concerned with high spreadsheet prices and the expensive hardware upgrades which are often required," said a CA spokesperson, "Users told us that they wanted the latest spreadsheet technology, but they needed it at a price they could afford and in one application that would run on all of their PCs. That is exactly what we're giving them. SuperCalc5 at this new low price is by far the best value in the spreadsheet industry."

Initial reaction amongst spreadsheet users and software dealers has been overwhelmingly positive. "This is terrific," said one user, "It's about

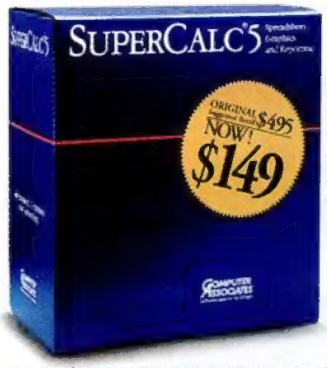
It's the beginning of a revolution.

The affordable spreadsheet revolution. Now every user in America can afford the most advanced spreadsheet technology. The latest breakthroughs. Newest features. Hottest 3-D graphics.

CA90s

CA's Computing Architecture For The 90s protects and enhances the value of every CA software solution.

It's all there inside SuperCalc5. With Lotus 1-2-3 compatibility, presentation quality graphics and spreadsheet linking, SuperCalc5 has become one of the most popular, best-selling spreadsheets in the industry.



More than 3,000,000 copies have been sold and unlike some others, SuperCalc5 runs on virtually every type of PC that exists.

If you've been thinking about moving up to a more powerful, full-featured spreadsheet, now's the time. Move up to SuperCalc5 and get everything you've always wanted for hundreds of dollars less than Lotus 1-2-3, Excel or Quattro Pro. For the name of your nearest SuperCalc5 dealer call 1-800-CALC-149.

Do it right now. After all, at this price, why wait?

COMPUTER ASSOCIATES
Software superior by design.

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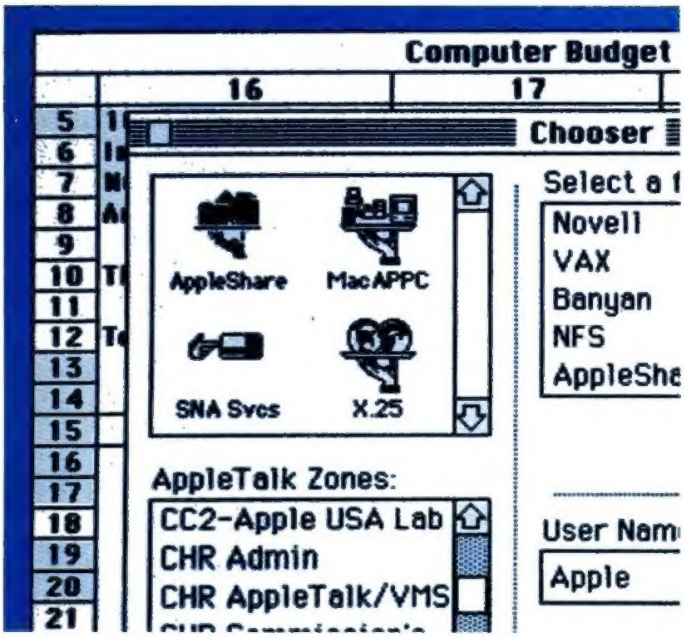
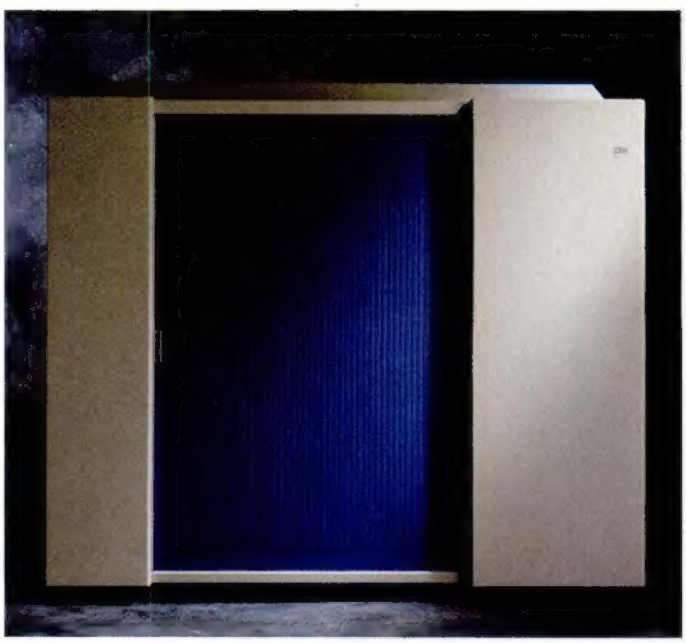
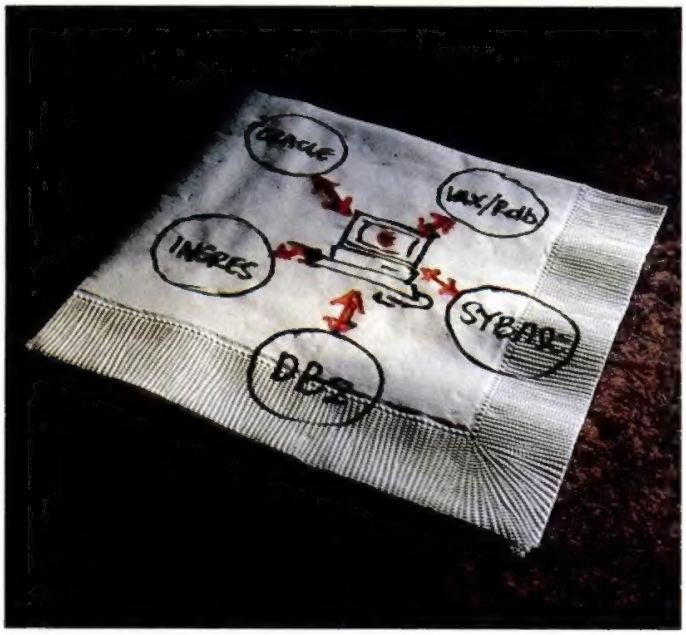
We're open



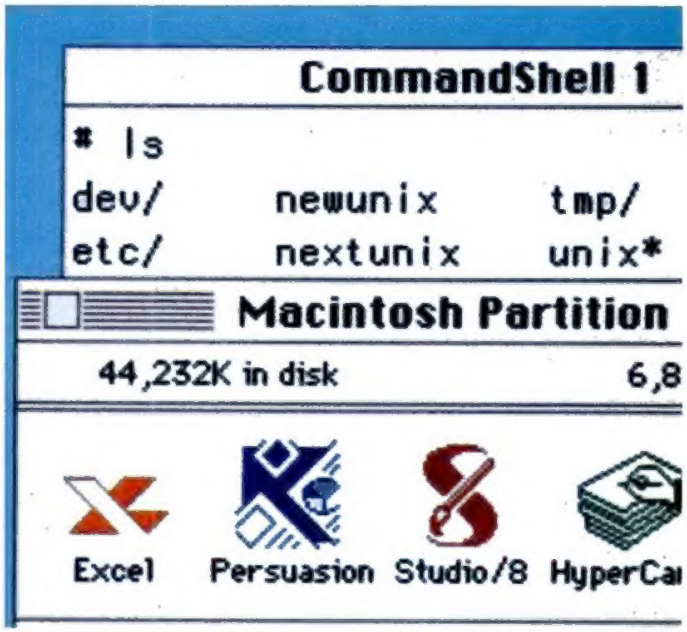
This is the Macintosh Chooser. A single point of access to a wide range of systems. The Chooser shows available network resources graphically and consistently. Just point the mouse and you're connected.



Macintosh offers an incredible range of tools for connecting with virtually any host-based environment, whether it's running SNA, TCP/IP, DECnet™, or OSI.



Apple's Data Access Language (DAL) adapts popular off-the-shelf database, spreadsheet, and data analysis software to major SQL environments. So nontechnical users can easily access remote databases.



Apple A/UX™ lets Macintosh run UNIX® applications plus thousands of Mac® programs. At the same time you can run X-Window and MS-DOS applications, and cut, copy, and paste between any of them. No other desktop computer can do this.

to anything.

Macintosh shares data with DOS PCs via Novell, 3Com, Banyan, and more. Macintosh reads and writes DOS files on a floppy disk. Macintosh runs DOS programs. Maybe your next DOS computer should be a Macintosh.

While diversity may make life rich and fascinating, it makes life as an IS manager something short of serene.

What is politely referred to as the "multi-vendor environment" is an amalgam of disparate hardware, incompatible operating systems, dissimilar databases, and multiple networks. Nevertheless, IS people are expected to make these all work together in perfect harmony.

But lately, a lot of people are finding the source of their solution a pleasant surprise: the Apple® Macintosh® computer.

They're finding that Macintosh comes out of the box with sophisticated networking capabilities designed right in.

That Macintosh is open to virtually any host, any file server, or any database, through any network.

That Macintosh makes the desktop the place where diverse systems come together.

And that with Macintosh you can build systems that let even nontechnical users access information from the desktop, no matter where that information resides.

And because Macintosh works with all your networks, databases, and hosts in one consistent and graphic way, it delivers major savings in implementation and training.

In short, Macintosh gives you the power to make information systems more valuable to the people who use them. The power to be your best.®

Information isn't much good to people who can't get to it. Macintosh sorts out the complexities of multiple computer systems and presents vast information to people at the desktop in a single, consistent way.

Macintosh gives people a single, simple view of the information and services that can help them do their jobs and serve your organization. See for yourself. Call 800-635-9550, ext. 670, and we'll send you a free video showing how Macintosh helps unify complex systems.

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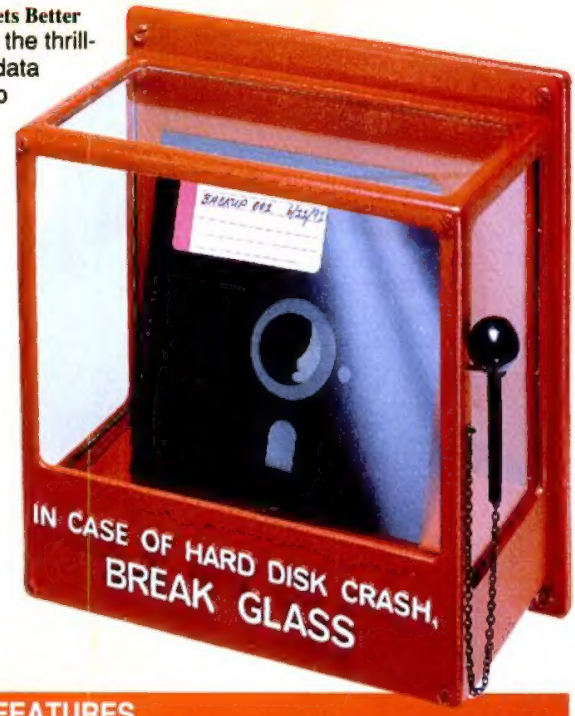

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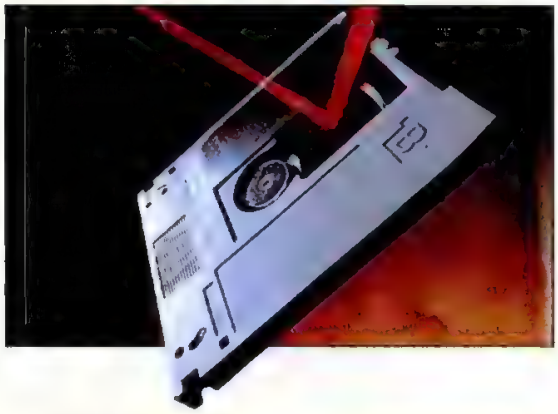

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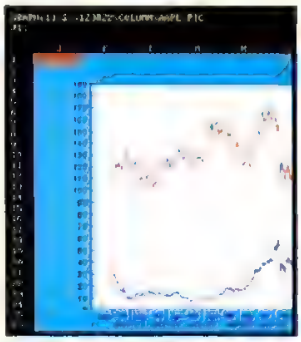

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What's the difference between an Austin and a Dell PC?

AUSTIN 486·33 EISA WINTOWER

$7,495

DELL SYSTEM 433TE

$9,649

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The Price.

Can two computer systems with similar features have such a huge difference in price? Yes! How? Just read the chart below.

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- **Award-Winning Excellence**
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PC MAGAZINE EDITOR'S CHOICE

- **Fully Loaded System**
  We configure every Austin WinStation (Window Workstation) to include a monitor, video adapter, hard drive, floppy, keyboard, and full array of I/O ports. Then we preload with Microsoft Windows 3.0 and DOS 4.01. We even include a Microsoft mouse. Other peripherals and options are available. Call for details.

- **American-Made Quality**
  Austin WinStations, including the surface-mounted motherboards, are made and assembled in the USA! The latest design and manufacturing techniques allow us to offer you the highest quality products at the lowest prices!

- **GE On-Site, Next-Day Service**
  Every Austin desktop comes with 1 year of GE on-site service. That means we'll have a Service Engineer to your computer site usually within 24 hours! We even offer extended GE contracts for up to 5 years at the best rates.

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- **Special Departments**
  Use our Certified NetWare Engineer to help you set up your own Local Area Network. Call us at **1-800-874-7182** and ask for the Networking Department. Austin Computers is a Novell Gold Authorized Reseller. We also have specific departments for VAR, Government, Education, and International clients. Ask about our quantity discounts.

Novell Gold Authorized Reseller

- **30-Day Satisfaction Guarantee**
  We want you to be 100% satisfied with your computer, your service, and us. That's why we give you a 30-day no-questions-asked, money-back guarantee.

- **100% Financing and Leasing**
  We offer 100% financing with our Austin Computer Systems Credit Card. Just call and we'll take your application over the phone.

What's The Big Difference?

Both companies give you high-quality systems, Editor's Choice awards, American-made quality, high performance, quality components, on-site service, full technical support, leasing options, 100% financing, and 30-day money-back guarantee. But, **Austin costs less!**

A close comparison...if you ignore the $2,154 difference.

Feature	**Austin 486/33 EISA**	Dell 433TE
486/33 MHz Processor	**Yes**	Yes
EISA Bus Architecture	**Yes**	Yes
330Mb Hard Drive	**Yes**	Yes
4Mb RAM	**Yes**	Yes
128K External Cache	**Yes**	Yes
VGA Monochrome Monitor	**Yes**	Yes
30-Day, Money-Back Return Policy	**Yes**	Yes
On-Site Service	**Yes**	Yes
Toll-Free Technical Phone Support	**Yes**	Yes
Leasing/Financing	**Yes**	Yes
Extended Warranty	**Yes**	Yes
Price	**$7,495**	$9,649*

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AUSTIN 286/16
STANDARD CONFIGURATION
Microprocessor: 80286 running at 16MHz.
Special Features: GE on-site service.
Storage: 40Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 1Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: TTL monochrome monitor with video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 286/16
1MB RAM AND 1 FLOPPY DRIVE
STARTING AT $1090 OR $33 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: TTL MONO CHROME	VGA MONO CHROME	VGA COLOR 640 X 480
40MB IDE	$1090	$1255	$1470
90MB IDE	$1310	$1435	$1650
125MB IDE	$1440	$1565	$1780
200MB IDE	$1820	$1945	$2160

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

Editor's Choice 386/SX16 1990

$1890

AUSTIN 386/SX16 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80386SX running at 16MHz.
Special Features: Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service.
Storage: 40Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 2Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor with 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 386/SX16 WINSTATION
2MB RAM AND 1 FLOPPY DRIVE
STARTING AT $1490 OR $45 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: TTL MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$1490	$1890	$2035
90MB IDE	$1755	$2095	$2215
125MB IDE	$1885	$2225	$2345
200MB IDE	$2285	$2605	$2725

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

Editor's Choice 386/SX20 U.K. 1991

$1990

AUSTIN 386/SX20 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80386SX running at 20MHz.
Special Features: Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service.
Storage: 40Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 2Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 386/SX20 WINSTATION
2MB RAM AND 1 FLOPPY DRIVE
STARTING AT $1845 OR $56 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$1845	$1990	$2180
90MB IDE	$2025	$2240	$2360
125MB IDE	$2155	$2370	$2490
200MB IDE	$2535	$2750	$2870

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

$2590

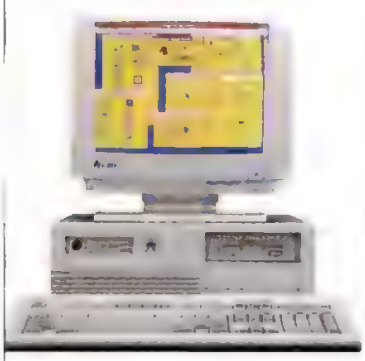
AUSTIN 386/25 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80386 running at 25MHz.
Special Features: Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service. Small footprint chassis.
Storage: 90Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 2Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 386/25 WINSTATION
2MB RAM AND 1 FLOPPY DRIVE
STARTING AT $2220 OR $67 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$2220	$2435	$2555
90MB IDE	$2400	$2590	$2735
125MB IDE	$2530	$2745	$2865
200MB IDE	$2910	$3125	$3245

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

Difference.



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STANDARD CONFIGURATION

Microprocessor: Intel 80386 running at 33MHz.
Special Features: 128K system cache. Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service. Small footprint chassis.
Storage: 125Mb IDE hard drive with 32K cache. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 4Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 386/33 WINSTATION
4MB RAM AND 1 FLOPPY DRIVE
STARTING AT $2820 OR $95 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$2820	$3035	$3155
80MB IDE	$3000	$3215	$3335
125MB IDE	$3130	$3345	$3435
200MB IDE	$3510	$3725	$3845

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

$3990

AUSTIN 486/25 WINSTATION
STANDARD CONFIGURATION

Microprocessor: Intel 80486 running at 25MHz.
Special Features: Internal 8K cache floating point unit. Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service.
Storage: 125Mb IDE hard drive with 32K cache. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 4Mb RAM (expands to 32Mb on system board)
Expansion: 8 16-bit ISA expansion slots
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 486/25 WINSTATION
4MB RAM AND 1 FLOPPY DRIVE
STARTING AT $3690 OR $117 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
125MB IDE	$3690	$3905	$4185
200MB IDE	$4280	$4475	$4595
330MB SCSI	$4730	$4945	$5085
1.2GB SCSI	$6180	$6395	$6515

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

$6730

AUSTIN 486/33E WINTOWER
STANDARD CONFIGURATION

Microprocessor: Intel 80486 running at 33MHz.
Special Features: EISA bus architecture. Internal 8K cache and floating point unit. Optional 64K or 128K external cache. Landmark v1.14 rating-167.8 MHz. Power meter rated @ 14.93 MIPS. Shadow RAM. EMS LIM 4.0 support. Microsoft package. GE on-site service. Vertical chassis.
Storage: 330MB SCSI hard drive.1.44 Mb or 1.2Mb floppy disk drive.
Memory: 8Mb RAM (expands to 64Mb on system board).
Expansion: 8 32-bit EISA bus master.
I/O Ports: 2 parallel and 2 serial ports.
Video: 14" VGA monochrome monitor. VGA video adapter.
Keyboard: Enhanced 101 keyboard.
Compatibility: Novell, DOS, OS/2 and Unix.

AUSTIN 486/33E WINSTATION
8MB RAM AND 1 FLOPPY DRIVE
STARTING AT $6730 or $177 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 x 768 VGA COLOR
330MB SCSI	$6730	$6945	$7065
1.2GB SCSI	$7990	$8395	$8515

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

$2295

AUSTIN 386/SX16 NOTEBOOK
STANDARD CONFIGURATION

Microprocessor: 80386SX running at 16MHz.
Special Features: Weight 6.1 lbs. without batteries. Notepad size. Dual removable battery packs for up to 7 hour battery life. Audio/Visual low battery warning indicator. Leather carrying case. Batteries and recharger included.
Storage: 20Mb hard drive. 1.44Mb floppy disk drive.
Memory: 2Mb RAM (expands to 8Mb on system board).
Expansion: 2 expansion pack slots. External VGA monitor port. External keyboard port. Printer port. 2 serial ports (1 for modem pack).
Video: Brilliant 10" VGA display with 640 x 480 resolution and 32-gray scale.
Keyboard: Low profile, full travel with embedded numeric keypad and 12 function keys.
Compatibility: DOS.

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CIRCLE 278 ON READER SERVICE CARD

Letters

REAL COMPUTERS DON'T USE GUIs?

I know John C. Dvorak hates GUIs ("The 'Intuitive' Computing Myth," March 12, 1991) and for a long time I had similar feelings. I used to think "real computers don't use GUIs." Then my eight-year-old son figured out how to get from *Windows'* main screen to Solitaire without any help from anyone.

The idea that installing a GUI on my computer could help me teach my son how to use a computer was enough to make me think about GUIs in a different light. Sure, they're slow, gobble up memory, and don't have the power or flexibility of the command line, but the icons make learning and using computers much easier for novices. Moving and dragging images is more intuitive than typing "CD dirname."

Habit often prevents us from seeing past our disgust with someone thinking they can come up with a better way of doing things we've done perfectly well for years. Sometimes it takes the intuitive innocence of a child to help us open our eyes to change.

Paul Oberholtzer
Morrow, Georgia

I've finally had it with Dvorak's arbitrary and capricious ranting and raving against GUIs. Although he is entitled to state his preference for entering commands from the keyboard, his snobbish attitude toward those who prefer to point and click borders on cultural fascism.

Visit any retail establishment—a baker, a camera shop, a jewelry store—how do people indicate their selections? They point. Even young children who have yet to master a spoken language instinctively know how to point.

Maloney
Van Nuys, California

I couldn't agree more with John C. Dvorak. The idea that a user should be able to master an elaborate computer program without a manual is absurd. Anyone disagreeing should try *PageMaker* or *Word for Windows* without a manual.

Dennis Vogel
Mobile, Alabama

As usual, John C. Dvorak stirs up a bit of controversy.

I take exception to Mr. Dvorak's March 12, 1991, column. After only a short orientation with the Macintosh, anyone can utilize nearly every piece of software. Printing, saving, formatting, and so on, are accomplished with the same stroke of the mouse in most software. Even more-complex skills such as desktop publishing or database development are easily acquired, once the basics are known.

The same cannot be said of PCs. Knowing *WordPerfect* gives no insight into *dBASE*. Yes, we must all be taught to use a computer. But wouldn't it be nice if we only had to learn once?

Aaron J. Press
Vienna, Virginia

MORE DVORAK

If John C. Dvorak can't find anything more interesting to write about than how lousy his trip to Fall Comdex was ("Comdex: Just Say No," February 26, 1991), then perhaps it's time for him to find another job. I subscribe to *PC Magazine* to keep up on the cutting edge of computer technology, not to listen to him whine about the woes of traveling. Really, John, my heart bleeds for you. But if you want to complain about your last trip, please tell your wife or your secretary about it.

David Baril
West Bridgewater, Massachusetts

In reference to John C. Dvorak's Inside Track, February 12, 1991, column: I am sure that *StarCOM* is a nifty utility for most of the uses that you suggest, but I hope that there are not many "rubes" who are willing to pay $59.95 for a utility to protect themselves from FORMAT. DELETE will most certainly "disable FORMAT" and RENAME (as the name suggests) will "change the command to a new name."

Jim Struve
Des Moines, Iowa

BACK TO BASICS

This letter concerns Bill Machrone's "Back to BASICs" column in the March 26, 1991, issue. Twenty *lines* of BASIC? How about 14 *keystrokes* of APL? Mr. Machrone suggests that the "interactive debugging" capabilities of BASIC make it "the only real choice," yet he completely overlooks a vastly more suitable approach: APL. APL is simple, quick, and ideally suited to ad hoc problem solving. What could be simpler?

Howard Gantz
Huntington Beach, California

HOW TO FIND IT

Why don't you guys have a comprehensive annual index? I hate having to scan magazine after magazine looking for a power programming tip that I know I saw sometime but can't remember when. Even the workaround of copying each issue's table of contents isn't satisfactory.

Bill Nelson
Simi Valley, California

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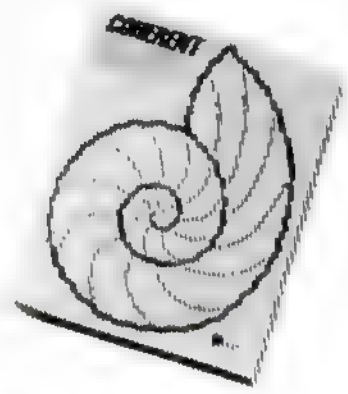

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Letters

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WANTED: COMPUTER TEACHERS

Donald W. Chilton (Letters, March 26, 1991) is as ignorant as he is well meaning. Needless to say, I agree with George C. Gross (Letters, December 11, 1990). Computers should be used to self-teach many subjects, so that students aren't bored to death by rigid teaching plans and pedagogical teachers. Students could progress at their own pace.

Too many of the teachers out there now are not caring enough, and they interject their own mean spirits into the learning process, turning their students off. Computers are unemotional; that's what's good about them. They don't care if a kid dressed funny; they just respond to the accuracy of the answers given and the questions posed.

People these days, and I don't mean just kids, are used to being entertained, or at least being kept interested. They learn more in those circumstances. Computers are better able to provide this stimulus than some teachers.

Let's keep the interesting and the caring teachers. Replace the rest with computers.

Charles Waldhauser
Baltimore, Maryland

DON'T FORGET US LITTLE GUYS!

You have almost totally left behind the small business, small entrepreneur, and home user in your recent issues. You ought to take to heart William F. Zachmann's March 26, 1991, column, and remember the thousands of us who cannot afford the time, money, and system requirements for *Windows* 3.0, not to mention all the high-priced software and hardware you seem mesmerized by, especially *Windows*. Frankly, I am sick of skipping over the many articles dealing with nothing but *Windows*.

Perhaps your future lies with the "big boys." If so, God speed. I will try to find a magazine (with your otherwise excellence) that has not forgotten the small user.

James Wheeler
Fulton, New York

STILL TALKING ABOUT THE STREET PRICE

I think Thomas J. Plunkett (Letters, February 26, 1991) missed the boat along with John C. Dvorak regarding "Street Price Apology" (Inside Track, November 13, 1990). Plunkett sounds like both a frustrated VAR and an ill-informed consumer.

> **If a VAR truly delivers value, a buyer should not hesitate to pay the street price of the product *plus* an explicit service charge.**

How often do people enter new car dealerships with the intent of paying full sticker price? On the other hand, even those people armed with *Consumer Reports* and actual dealer cost printouts are reasonable enough to expect that dealers have salaries, commissions, and other expenses to pay.

If a VAR truly delivers value, a buyer should not hesitate to pay the street price of the product *plus* an explicit value-added service charge.

Ronny Ong
The Colony, Texas

A BAD REVIEW

I completely agree with Co Crocker's letter in the March 12, 1991, issue. The foldouts are an inexcusable nuisance. Moreover, is there a law that says advertisements can't have page numbers? Ten-page ads make it impossible to find the article you are looking for. I would read the ads even if they were all relegated to the back (or the front) of the magazine.

Wake up, *PC*! You would give a software package that was as "user friendly" as your magazine a very poor ease-of-use rating.

Bill Cunningham
Woodridge, Illinois

THE RIGHT DECISION

FEBRUARY 18 1991

PC WEEK \ REVIEWS

PAGE 92

PC WEEK LABS PRODUCT REVIEW

Tri-Star Leads 33MHz 486 PC Pack

Eight Low-Cost Systems Perform Well; Video and Hard-Disk Components Va

By David Claiborne

"Tri-Star is king of the 33MHz 486 Mountain."
PC WEEK
Analyst's Choice, February 18,1991

Tri-Star Computer continues to outdistance the pack as America's prefered supplier of high-end 486 Workstations. Read the reviews and you will understand why Tri-Star is the undisputed 486 champ.

"Tri-Star's 486/25 rates honorable mention for its thoughtful design touches, two year warranty and excellent service program."
PC Magazine
Editor's Choice Honorable Mention, September 11, 1990

"Tri-Star's edge is its good documentation and excellent service policy."
PC Sources
486/33 Lead Review, February 1991

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CIRCLE 121 ON READER SERVICE CARD

"A Solid, Complete Machine For The Rest Of The

Weight It is important for a notebook PC to weigh at least 6-7 lbs. Many of our customers (and even Computer Shopper) who have had experience with the 4-5 lb. "lightweights" all agreed that they are too flimsy. The 6-7 lb. machines offer a much sturdier box and will work out better in the long run.

Keyboard The layout of a keyboard and the size of the keys make all the difference in the world. Is there a large enter key? Is the "Ctrl" key in one of the two normal spots? Are the arrow keys arranged in an inverted "T" fashion? Is there an external keyboard connector?

Size How easily will the notebook, along with the AC adapter, fit into a brief case? Specifically, will the notebook fit side-ways into half of your briefcase? Sounds minor, but it's important.

Speed You can never have too much of this valuable commodity. A 12 or 16MHz machine may be adequate for some uses but Windows users and those who operate in graphics-intensive environments really appreciate the extra MIPS.

Memory **Expansion:** Does the computer use industry standard memory (SIMMs or SIPs), or does it use proprietary memory? If proprietary memory: (1) Will the company be around long enough to allow future upgrades? (2) How much does the proprietary memory cost? (3) What happens when a product is discontinued?

$2650

NB/320SX
20MHz/LCD/VGA
2MB/20MB HD

Expansion **Chassis / Docking Station:** Availability of an expansion chassis will effectively guarantee your notebook's future in the event you eventually require a LAN adapter, scanner card, tape backup, or similar peripheral device.

Screen The good notebooks use the latest triple-twist LCD technology which provides great clarity and excellent readability. Low-end notebooks tend to use the older double-twist screens which will fade out when being viewed from an angle.

I/O Ports A complete notebook should have at least one parallel port, two serial ports, a VGA monitor port, K/B port for your favorite keyboard, and an internal modem slot.

Battery In general, a notebook's battery will carry a 2-hour charge or more. Is there a "suspend" button for use when the battery is replaced? How much does a spare battery cost? Recharger?

Return **Policy:** Regardless of the ad, make sure the money back guarantee is a no-questions-asked deal. And make them state specifically that there is no restocking fee. You want a couple weeks to see if you feel comfortable with the system. Be prepared, however, to pay the round-trip shipping charges if you choose to return the system.

Price The big thing here is value. Comparison shop the exact configuration you intend to own in six months. Do not assume that peripherals purchased later will be priced the same by all manufacturers. High-priced add-ons to a cheap system may reverse rankings made strictly on base prices.

That Sets The Standard Industry...."

March 1991, Computer Shopper

Notebook Buyers' Checklist:

Standard Features	DATAWORLD NB-320SX	BRAND X
Weight	7 lbs	
Processor type	80386SX	
Processor speed	20 MHz	
Base Memory	2 MB	
Floppy drive	1.44 MB	
Display technology	Triple twist VGA	
Display Resolution	640×480, 32 gray scales	
Battery Type	Nicad D-cell	
Parallel port/Serial ports	1/2	
Dedicated modem slot?	✓	
External VGA support?	✓	
External keyboard support?	✓	
Expansion box available?	✓	
DOS included?	✓ (4.01)	
Carrying case included?	✓	
Other software included?	✓ (FastLynx)	
Optional Features:		
Memory upgrade path	4MB, 8MB, 16MB	
Hard drives available	40MB, 60MB	
Numeric coprocessor	387-20SX	
Replacement battery	✓	

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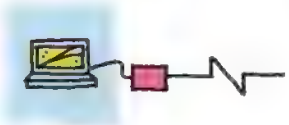

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CIRCLE 104 ON READER SERVICE CARD

Letters

Hey!! What's the matter with these guys? Can't they put their minds to work and come up with some uses for your inserts? I can't read your whole magazine in one sitting, so I find one of your inserts and use it as a bookmark.

If I have to write a note and don't have a piece of paper handy, guess what? I use inserts (the mag's glossy paper is not a good writing surface).

So leave the little creepers alone. I like them and am sure a lot of other people like them too.

Frank Martinez
Miami, Florida

> If you were to max out your 64-bit PC at $80 per megabyte, that much memory would run you 500 times the national debt.

HOW MUCH ADDRESS SPACE DO WE REALLY NEED?

Seymour Metz's letter (Letters, March 12, 1991) concerning the need for 64-bit addressing in our lifetime, got me thinking about the amount of information represented by an address bus of that width.

At 20,000 characters per double-sided page, that's over 75 stacks of paper, each reaching from here to the moon. If you were to max out your 64-bit PC at $80 per megabyte, that much memory would set you back almost $1,500,000,000,000,000 or about 500 times the national debt. Of course, with that kind of order, I suspect you could finagle a pretty good discount, although it would probably take a couple of extra days to have it filled.

Then the problem would be where to put it all. Using standard 1MB SIMMs, I calculate that that much memory would physically take up about 8 billion cubic feet, or a cube measuring 2,000 feet on each edge. Therefore, I strongly suspect it would be available only in a tower configuration.

Steve Offner
Carlsbad, New Mexico

CORRECTIONS & AMPLIFICATIONS

In the April 16, 1991, New and Improved column, the telephone number for Ontrack Computer Systems should have been 612-937-1107.

In the April 16, 1991, "Unleashing EISA's Power," article, we stated that just one fan cools the 33-MHz Dataworld Data 486i EISA. There is a second fan.

In the March 26, 1991, cover story, "16-Inch Monitors: Sized for Super VGA," we gave the wrong street price for the NEC MultiSync 4D. We said you could buy it on the street for under $900. Further research shows that a more realistic street price is about $900 to $950.

In "System Setup: The Inside Story" (March 26, 1991), we said that *ASQ*, Version 1.1, reported files and buffer information as it appears in CONFIG.SYS rather than the true numbers. True numbers are included as part of the low DOS memory report.

In the Ergo Brick sidebar to "AC-Only 386 Portables" (March 12, 1991), we should have said that the $3,589 Brick configuration included a Mag monitor with an 800-by-600 noninterlaced and 1,024-by-768 interlaced resolution in this configuration. We also should have said that Ergo's basic $2,695 configuration comes with 4MB of RAM.

In the March 12, 1991, New and Improved column, Xing Technology's telephone number should have read 805-473-0145.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments, complaints, insights, and suggestions. Please send them to Letters, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see page 8 for access information). All letters become the property of *PC Magazine* and are subject to editing. ■

SEE US AT COMDEX, BOOTH 1905

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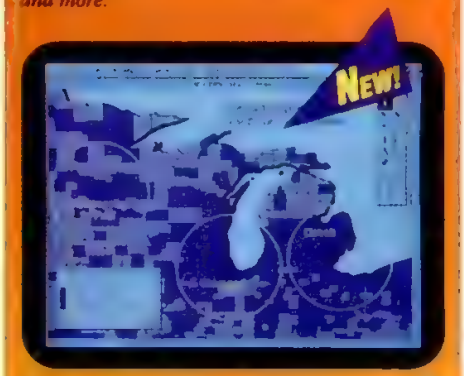

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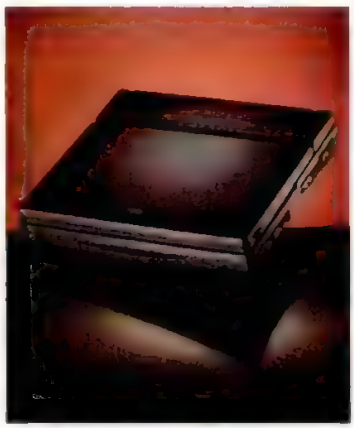

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Your new ZEOS notebook is a great connectivity tool! Using our optional built-in 2400 baud MNP Class 5 modem, connectivity buffs will find themselves logging on at every turn.

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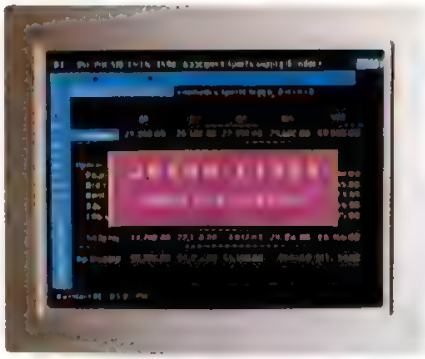
Red Cross Virus. Ambulance randomly moves across bottom of display.



Friday 13th Virus. Alias "Black Friday." Erases programs when you try to run them.

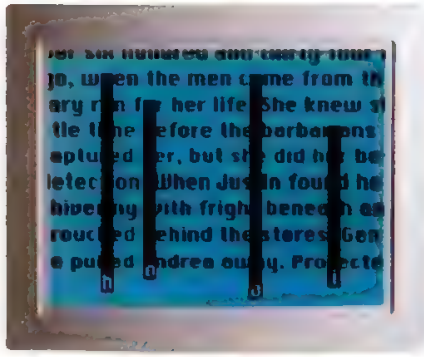
Disk Killer Virus. Alias "Ogre." Causes unexpected formatting of your hard disk.

Stoned Virus. Alias "Hawaii." Data loss caused by damage to directory and FAT.

Datacrime Virus. Adds garbage to files and reformats disk.

AirCop Virus. Alias "Red State." Attacks boot sector on non-write-protected diskettes.

Ping Pong Virus. Alias "Bouncing Ball." Wipes characters off the screen.



Falling Letters Virus. Characters fall to the bottom of the monitor. Creative, but a real nuisance.

With over 50 new viruses each month, who knows what's next.

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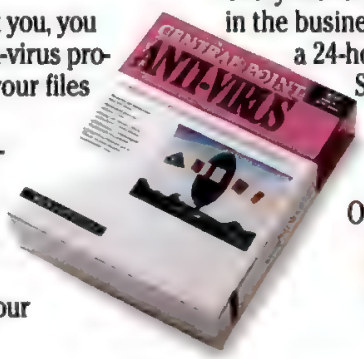

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CIRCLE 162 ON READER SERVICE CARD

by
Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

OS/2 to Be the Cornerstone Of Compaq's RISC Open Systems Architecture

The full extent of Microsoft's rift with IBM is becoming apparent now.

First, we saw IBM endorse Novell's *NetWare* products—not Microsoft's *LAN Manager*—to supplement IBM's *PC LAN* products. Now Microsoft is turning OS/2 into the centerpiece of a Compaq-led alliance designed to take control of RISC-based workstation standards.

The new alliance was announced exactly four years and one week after IBM presented OS/2 as the cornerstone of IBM's strategy for taking PCs to a multitasking environment that would be integrated into IBM's bigger systems, including RISC computers.

The new group is propagating a standard called the Advanced Computing Environment (ACE) and the leading conspirators are Compaq, Control Data, DEC, and Tandem—all of them looking for an opportunity to share in the workstation market that HP, IBM, and Sun are carving up among themselves. (While DEC helped create the market, it has become outflanked and needs help to regain lost market share.)

ACE's basic concept is that by setting standards, these companies can offer both CISC- and RISC-based machines that run both DOS and Unix software.

The two hardware standards are Intel's 32-bit PCs (386, 486, and up), and MIPS' microprocessors (R3000, R4000, and up).

Today's generation of 32-bit PCs will be in compliance with ACE; none of the RISC systems on the market will be, including those that use the R3000. That specification (to be known as ARC for Advanced RISC Computing) is under development and, according to the group, will be given to any computer maker who wants to take part.

The two software standards are OS/2 3.0 and Open Desktop, a unified Unix that will be developed by The Santa Cruz Operation. Open Desktop will be binary-compatible with Ultrix/MIPS applications, will incorporate Unix System V, OSF/Motif 1.1, and X Window System 11.4, and will comply with X/Open, POSIX 1003.1, and SVID 2 standards.

Since Microsoft has already started talking about making the 32-bit version of OS/2 portable, this doesn't represent a shift in its strategy (see Pipeline, April 16, 1991); Bill Gates continues to talk about the new technology in the 32-bit version of OS/2 that will allow it to run today's DOS and *Windows* applications on many platforms.

And now that Microsoft is charting a course that's increasingly independent from IBM, this type of alliance is perfectly natural. It helps rein in more systems developers who'll build computers guaranteed to run OS/2. It may even give Microsoft a specification so solid that it can sell OS/2 as an off-the-shelf, shrink-wrapped product, available for either Intel or RISC machines.

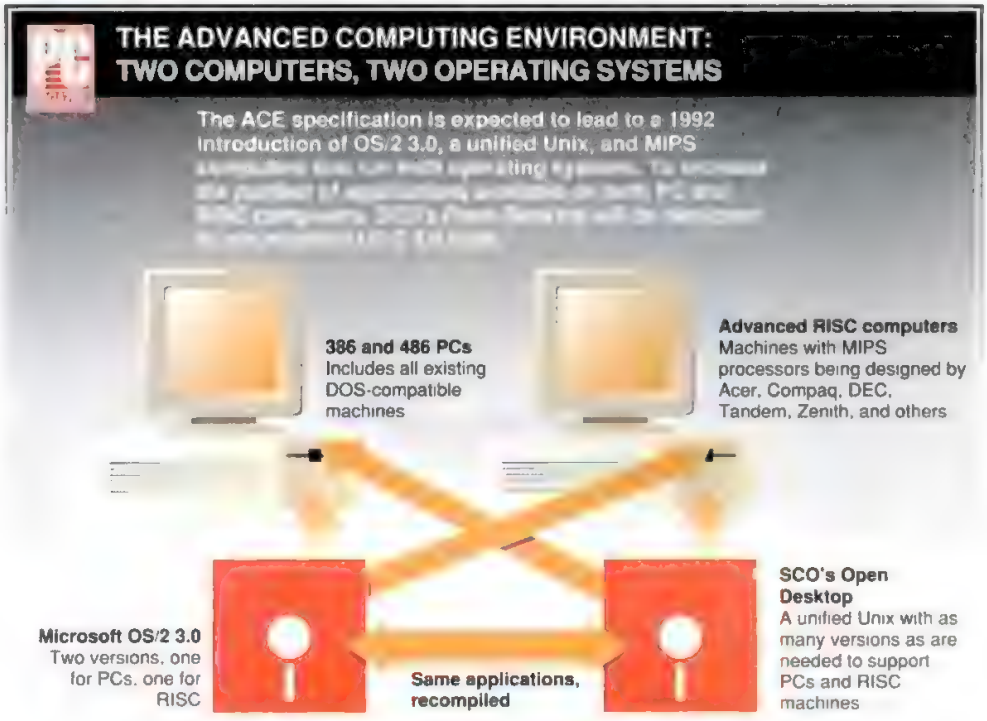
That helps Microsoft become even more independent; no more need to wait for a systems manufacturer to market new hardware so that Microsoft can license a new version of DOS, the way Microsoft once had to wait for IBM to build new features into its PCs so that DOS could be upgraded.

Microsoft is only a few weeks away from this type of independence with DOS 5.0, which will be sold as a genuine off-the-shelf product that promises compatibility with any PC.

One of the chief obstacles to OS/2's initial reception was the lack of intersystem compatibility. The owners of millions of third-tier 386-based PCs had no way of knowing if there would ever be a version of OS/2 that would be guaranteed to work on their systems.

The new ACE standard gives OS/2 a second lease on life. And because Microsoft will work closely with its longtime partner SCO to ensure compatible specs, applications written for either OS/2 3.0 or Open Desktop can

CONTINUES ON PAGE 30



Pipeline

CONTINUED FROM PAGE 29

be compiled to run under both operating systems—after "minor modifications" (Bill Gates's term) are made to the code.

Ironically, even though IBM's RS line will face dramatically increased competition from ACE machines, the company's investment in OS/2 may pay off as a result of this new alliance.

So why's Compaq doing it? To lessen the risk of entering the workstation market.

In looking to grow beyond the increasingly competitive PC market, Compaq would have to spend heavily to establish an unknown RISC processor.

Its other choice is to go with one of the leaders. That means supporting Sun's SPARC specification, in which case Compaq is merely following the lead of a giant. Or buying Intel's 860, which is not a true RISC chip, but a graphics coprocessor with enough additional functions to qualify as a RISC processor.

Compaq feels it has a chance to grow with MIPS and to influence the company's future plans; by bringing other computer companies along, it shares the risk of entering the market.

Compaq also believes it has an ace in the hole: It owns 13 percent of Silicon Graphics and has signed a technology-sharing agreement that may give Compaq an edge in the workstation competition.

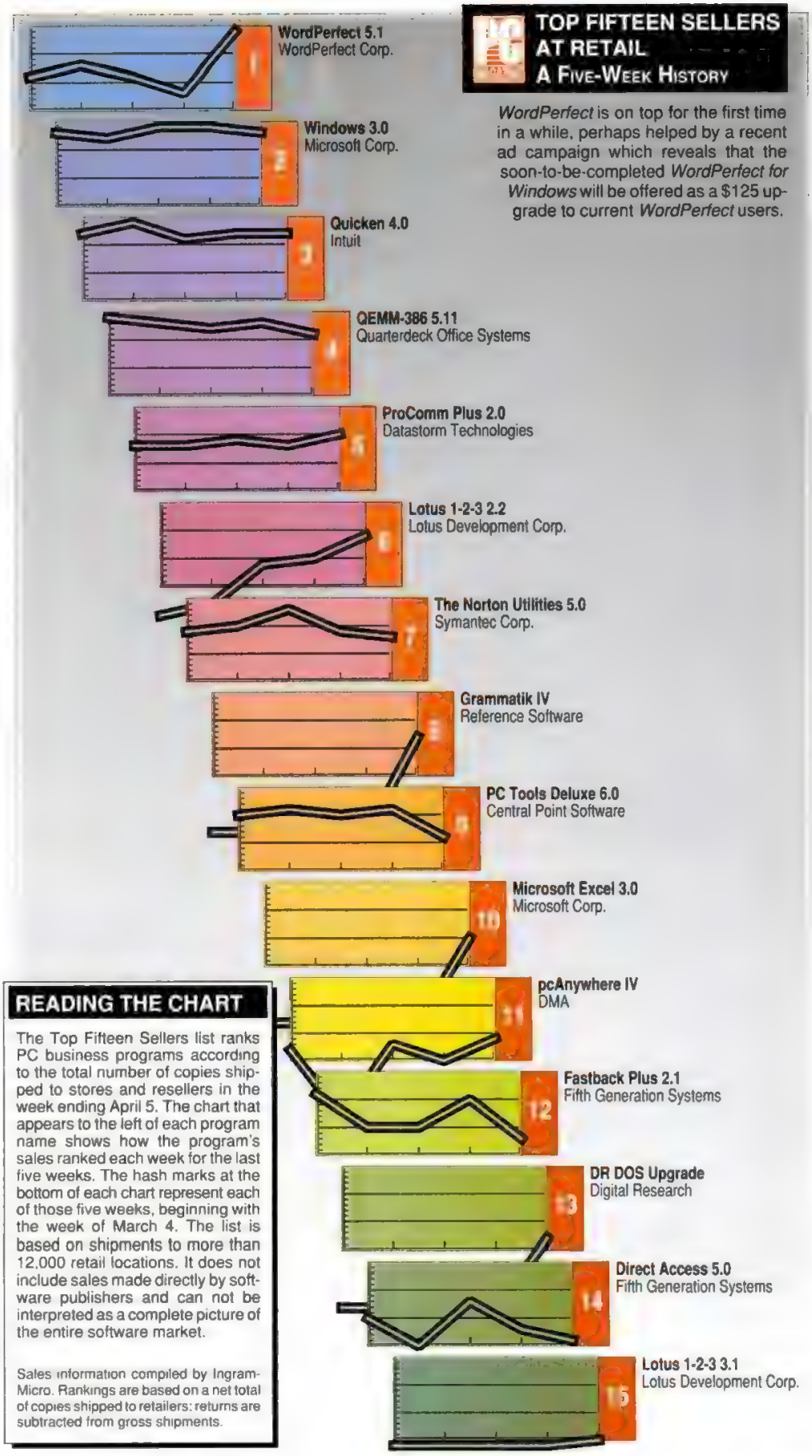
Since Microsoft has announced that it will be incorporating Silicon Graphics' 3-D technology into future software, Compaq may well find itself sitting in the driver's seat when ACE machines finally reach the market.

The good news for PC users in all this is that companies like DEC and Control Data are becoming involved for one reason: to gain access to the large base of existing DOS and *Windows* applications without resorting to competing in the cutthroat 386-based PC market.

That can only make today's DOS, *Windows*, and OS/2 software an even stronger investment over the long term. ■

TOP FIFTEEN SELLERS AT RETAIL
A Five-Week History

WordPerfect is on top for the first time in a while, perhaps helped by a recent ad campaign which reveals that the soon-to-be-completed *WordPerfect for Windows* will be offered as a $125 upgrade to current *WordPerfect* users.



READING THE CHART

The Top Fifteen Sellers list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending April 5. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of March 4. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a complete picture of the entire software market.

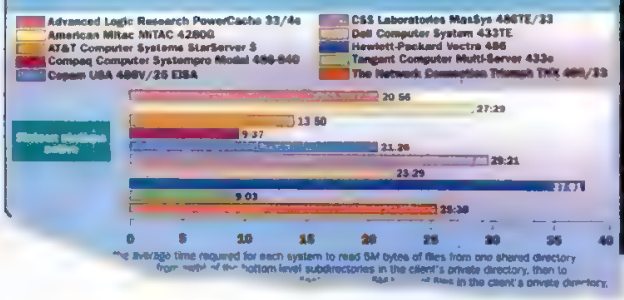
Sales information compiled by Ingram-Micro. Rankings are based on a net total of copies shipped to retailers: returns are subtracted from gross shipments.

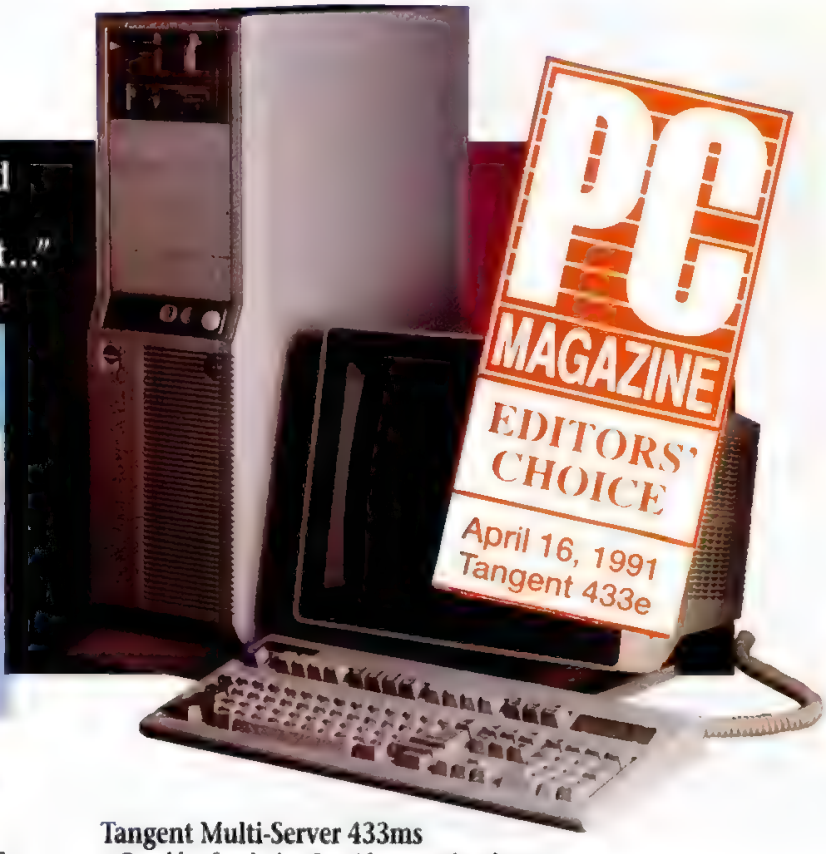
Once again, editors rave about the Tangent 486.

"...when the full 16 stations included in the test were active. The Tangent Multi-Server 433e was still the fastest..."
PC Week 1/7/91

PC WEEK

Tangent Server Maintains Performance Lead As LAN Size Increases





"A consistently strong performer across all tests, the Tangent model 433e stands out in this group." PC Magazine April 16, 1991

PC MAGAZINE EDITORS' CHOICE
April 16, 1991
Tangent 433e

PC Magazine, April 16,1991

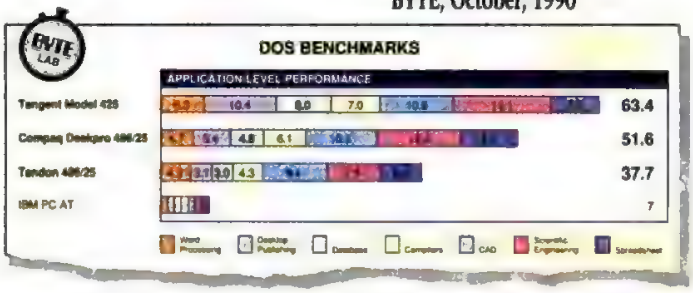
TANGENT COMPUTER INC.

Tangent Model 433e

by Bill O'Brien

Tangent Computer's foray into the realm of the EISA bus is represented by an investment-quality machine.

"The big winner is the Tangent..."
BYTE, October, 1990



When the editors got through writing about Tangent 80486 systems, they didn't leave us a lot to say. Except price. First, compare performance. Then compare price. What you'll see is that Tangent is the price-to-performance leader in 486 systems, with a range of models designed to fit any need.

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First Looks

Hands-on Reviews of the Latest Products

Four 486SXs: Is the Glass Half Empty or Half Full?

Disabled FPU Should Help Bring 486 Price Down

HANDS ON
by Christopher Barr
and Matthew J. Rose

IBM, Advanced Logic Research, American Mitac, and AST Research all have chosen slightly different ways to design their Intel 486SX-based PCs, but there are certain consistencies in performance.

Intel promises the 486SX's performance is two to three times faster than a 33-MHz 386; but that performance time only applies if you're using a 32-bit operating system. A 33-MHz 386 makes more sense for those looking for a machine with optimal performance in today's DOS/*Windows* 3.0 world, although operating systems like Unix, OS/2 2.0, and *Windows* 4.0 will ultimately give the 486SX an edge.

If your application requires a coprocessor, you should also stay clear of the 486SX, even with its 487SX upgrade potential. The 486SX is designed for budget-conscious gamblers—those willing to stake the future on a 32-bit operating system, but not willing to stake big bucks for the privilege of being right.

IBM, Mitac, ALR, and AST (left to right) are among the first 486SX computers manufacturers have shipped.

PHOTOGRAPHY: THOM O'CONNOR

IBM PS/2 Model 90 XP 486

From the outside, the new PS/2 Model 90 XP 486SX is identical to the small-footprint 486DX-based Model 90 IBM unveiled earlier this year. The similarities continue inside these machines; they share the same chassis and basic design: four 32-bit MCA slots, one slot with IBM's Micro Channel video extension, a fifth 64-bit dedicated CPU slot, a CPU daughtercard, and XGA graphics.

A 486SX offering in IBM's product line comes as no surprise, especially since IBM has so fully embraced the notion of an upgradable CPU card. The backplane design, central to the Model 90 line, facilitates quick production of new systems.

While the overall machine design offers few surprises, the daughtercard houses surprises aplenty. Uncharacteristically, the board has some wire traces, indicating that the Model 90 SX was probably modified from a standard 486DX. According to IBM, they will be corrected in the next board revision.

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LANstep: Hayes' entry-level LAN marches to its own drum 37

microLaser XL: TI shaves dollars and size from network printing 38

Harvard GeoGraphics: Low-cost data-driven mapmaking 48

Portable TrackMan: Logitech takes a new angle on portable pointing 50

486SX: Upgrade Now and Upgrade Later

by Christopher Barr

Intel is offering the 486SX as a low-cost entry point to 486 computing in the same way that it capitalized on the 386SX to encourage users to migrate from the 286 platform. A key difference between this and the earlier SX is that this time Intel is faced with a strong challenge from AMD's 40-MHz AM386 chip.

Intel's 486DX processor runs at 25 MHz or 33 MHz and has an internal floating-point unit (FPU). The 486SX is really a full 486DX chip with the floating-point unit disabled. According to Intel, disabling the math transistors was the most cost effective, speediest way to modify the 486SDX.

But Intel is hedging its bet on the 486SX. It's not convinced that users will be happy with the chip's lack of a floating-point unit.

The disabled chip sets the stage for Intel's larger plan: For a $799 list price, Intel offers the 487SX math coprocessor, which is nothing more than a fully functional 486DX with two differences:

1) Special logic in the chip enables it to override the 486SX; in effect, putting it into a coma.

2) The 487 has an additional pin—it has 161 pins versus the SX's 160—which is used only to send a knockout punch to the 486SX.

Clearly the SX is a marketing innovation, rather than a technical one.

Intel may lose market

CONTINUES ON PAGE 36

486SX

CONTINUED FROM PAGE 35

One of the more pleasant surprises in the desktop we reviewed was the 400MB SCSI hard disk combined with a 512K caching SCSI controller. Formerly available only in the P75 486 portable, this drive is now available as an expensive $6,400 option to any IBM PC. And, in addition to the base price $8,345 desktop Model 90 SX, IBM has also announced a tower-based, Model 95.

With prices as high as $13,000 for the tower Model 95 SX (with the 400MB SCSI drive standard), IBM's implementations of the Intel P23 chip don't come cheaply. The 512K-cached SCSI hard disk controller and fast 400MB hard disk promise high performance, but IBM's 486SX did not distinguish itself from the competition on our benchmark tests. IBM offers no external RAM cache, but its CPU performance under DOS did not suffer when compared with those with external caches.

Two memory boards extend vertically from the motherboard, equipped with a total of 4MB of 70-nanosecond interleaved page-mode memory, up to a maximum of 32MB. IBM admitted that there wasn't space enough to fit a 487 upgrade on the CPU board. IBM will replace the SX chip with a 487 for $1,345 (available in July), a 25-MHz 486DX for $2,745, or a 33-MHz for $4,445.

Other Model 90 SX features include XGA graphics integrated on the motherboard with 512K video memory standard, expandable to 1MB; one external and two internal 3.5-inch drive bays, plus an external bay for IBM's new slimline 5.25-inch floppy disk. As configured, the Model 90 SX offers three free slots for adequate expansion.

The 32-bit processing power of the Intel 486SX, combined with IBM's Micro Channel architecture and plans for OS/2 all come together in the solid, well-built Model 90 SX. At $9,445, IBM does not offer much added value to justify the price of a system that is meant to be a low-cost entry into the world of 486-based computing. ■

List Price: IBM PS/2 Model 90 XP 486SX, with 4MB RAM, 80MB SCSI hard disk, $8,345; with VGA, DOS 4.01, $9,445. IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-IBM-2468.

CIRCLE 712 ON READER SERVICE CARD

486SX: Upgrade

CONTINUED FROM PAGE 35

share to AMD's 40-MHz 386. By migrating users to the 486 platform, Intel is playing in an arena where AMD still can't compete.

The 80486DX is a better processor than the 80386, but what about the 486SX? Like the 386SX, it has full 32-bit internal processing, but unlike the 386SX, which has 16-bit I/O, the 486SX has fast 32-bit I/O.

The memory functions in both versions of the 486 are better integrated than in the 386's: 486DX and SX have on-chip 8K caches that improve memory access times, and a burst mode to read large blocks of data at close to twice the speed of a 386.

PC Magazine Labs benchmark tests show that machines running the 20-MHz 486SX are slower than both the Compaq 386/33 and the Bell 386/40 (which has the AM386 40-MHz chip).

Unlike the benefits gained by migrating from the 286 to the 386, the 486's refinements over the 386 offer no compelling reason to migrate. Intel claims that a 486 will dramatically outperform a 386 when running software that uses 32-bit instructions; but while Microsoft has such designs in store for *Windows* and OS/2, it will be at least a year before they're marketed.

If you run CAD software or crunch numbers on worksheets that use floating-point math, then your choice is clear: You need a 486DX machine.

If you plan for the long haul, buy a 486SX as an investment in the future.

And if you're most concerned about getting speed now, go for the MHz.

INTEL GETS SLIGHTLY MORE PRICE-COMPETITIVE

A look at Intel's recent price cuts on PC processors demonstrates that the 486SX is part of a marketing plan, not a technical innovation. The 486SX's price establishes it as a direct competitor to AMD's AM386 chip and an alternative to faster 386s. The higher price for 486DX chips maintains the premium that Intel places on math coprocessing. These prices are for lots of 1,000 on Intel's chip; AMD's is for lots of 100.

	First Quarter 1991	Second Quarter 1991
Intel 486DX/33	$860	$667
Intel 486DX/25	$671	$588
AMD AM386/40	N/A	$297
Intel 486SX/20	N/A	$258
Intel 386DX/33	$214	$208

ALR Business-VEISA 486ASX

ALR has a history of being one of the first PC manufacturers to support any new Intel processor. That's easy for the company to do, since it has long been committed to upgradable CPU systems. The BusinessVEISA motherboard remains the same regardless of which processor you use because ALR puts the CPU and its support logic on a 32-bit plug-in card.

This time, the company retrofit its BusinessVEISA 486/25 with the slower 20-MHz 486SX processor. We tested the fully loaded Model 150HP, which lists for $6,195, and comes complete with a high-speed disk subsystem. A stripped-down version, the Model 101, is equipped with only a floppy disk drive and lists for $2,795.

While the BusinessVEISA 486ASX did not distinguish itself on our tests, you can easily upgrade the unit by purchasing the $799 Intel 487SX chip and plugging it into the card, or using ALR's $1,095 486/25 upgrade card.

The 486ASX is a full-height small-footprint model with an updated motherboard design. The unit has nine expansion slots: two 16-bit ISA, four 32-bit EISA, and three 32-bit proprietary ALR slots for the processor, external RAM cache, and additional memory. There are a total of four storage bays, enough to load two half-height and two 3.5-inch drives. The motherboard contains an IDE interface and floppy disk interface, and can address up to two of each device.

The ALR BusinessVEISA 486ASX is a solid machine. The 32-bit EISA bus takes advantage of the 32-bit data path of the 386DX and 486 processors, and ALR's upgradable architecture scheme is one way for users to plan against future obsolescence. ■

List Price: BusinessVEISA 486ASX Model 150HP with 5MB RAM, 150MB ESDI hard disk, 32-bit ESDI cache controller with 1MB cache, 1.2MB and 1.44MB floppy disks, Super VGA adapter with 1MB RAM, Super VGA monitor, 64K SRAM cache, $6,195. Advanced Logic Research Inc., 9401 Jeronimo, Irvine, CA 92718; 800-444-4ALR, 714-581-6770.

CIRCLE 707 ON READER SERVICE CARD

CONTINUES ON PAGE 37

First Looks

486SX

CONTINUED FROM PAGE 36

Mitac 4270E

American Mitac, the second largest Taiwanese PC manufacturer behind Acer, has built its reputation by doing things conservatively, using solid components and following industry trends. Suddenly Mitac is taking the lead by offering a stripped-down version of its 486SX at $2,995. The 4MB RAM, 100MB hard disk, VGA system sent to PC Magazine Labs costs a bit more: $4,515.

Since Mitac's 486SX machine uses the same small-footprint EISA motherboard as its 25-MHz 486, it cannot house both the 486SX and the 487 chip on the systemboard simultaneously. Coprocessor support is limited to a Weitek 4167, but an authorized Mitac representative can remove the 486SX chip and replace it with a 487 chip.

The 4270E features an external 64K write-back processor cache, expandable to 128K or 256K of SRAM—which may be overkill. In our testing, the external cache didn't improve performance over the machines which rely solely on the 486SX CPU's internal 8K cache.

The Mitac we tested featured a Conner 100MB IDE hard disk and five EISA 32-bit expansion slots. One of these slots is occupied by a Super VGA card offering 800 by 600 resolution in its standard 256K memory configuration. A proprietary 32-bit slot holds the system's memory card populated with four standard 1MB SIMMs; maximum system memory is 64MB.

The Mitac 4270E offers solid, conservative construction. As the lowest entry point to 486SX EISA computing, it's worth a look if you don't need a coprocessor. ■

List Price: Mitac 4270E with 4MB RAM, 100MB hard disk, VGA with low-radiation monitor, DOS 4.01, $4,515. American Mitac Corp., 410 E. Plumeria Dr., San Jose, CA 95134; 800-648-2287, 408-432-1160.

CIRCLE 713 ON READER SERVICE CARD

AST Premium II 486SX/20

AST Research offers yet another flavor to the 486SX stew. Like ALR and Mitac, its has a sub-$3,000 price tag on its totally stripped system. Like ALR and IBM, the AST 486SX resides on a CPU daughtercard, with no external memory caching—but the similarities end there.

Unlike the other SXs, AST uses its own 32-bit Cupid architecture in the AST Premium II 486SX/20, in addition to its standard Industry Standard Architecture (ISA) in its Premium II 486SX/20. The unit features six expansion slots: one 8-bit, and five 16-bit ISA. (Other machines reviewed here support either 32-bit EISA or MCA I/O.)

Three of AST's ISA slots can support a 32-bit AST Cupid card; it is here that the CPU/memory card resides. The CPU board holds up to 16MB of RAM, with 80MB maximum expansion through two additional Cupid memory cards.

Like IBM, AST did not implement an external memory cache. Still, the Premium II performed admirably. Using 70-nanosecond 1MB SIMMs in a proprietary 64-bit wide memory bus, accessing 64 bits of memory at a time, and using a page-mode architecture to support line fill and the Intel 486 burst mode, this proprietary structure shows that an external cache is not necessary for DOS application. There is a socket for the 487SX, but Weitek support is unavailable, and AST does not intend to offer a 486DX version in this AT-bus–based machine.

The system's video resides on the motherboard: 256K of memory provides 16-bit, 800 by 600 Super VGA graphics. Three external drive bays, plus two more internal drives offer plentiful expansion options. Our evaluation unit has a 3.5-inch floppy disk, 200MB Seagate IDE hard disk, and a manually switchable 145-watt power supply.

AST's 486SX raises an important question; Does an ISA-based version of the new Intel CPU makes sense if you're looking to benefit from future 32-bit architecture? Probably not. Apart from that, the AST Premium II 486SX/20 is solidly built. Its 487 chip socket offers the easiest upgrade—one that end users can perform. ■

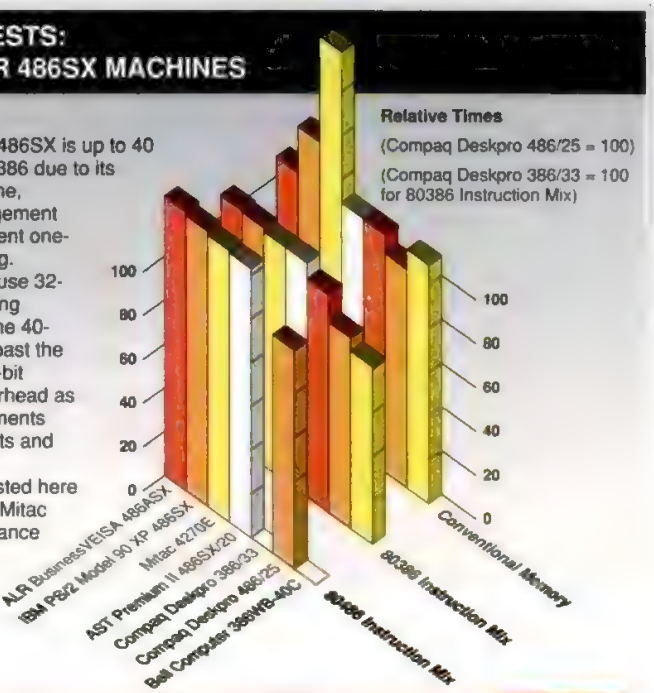
List Price: AST Premium II 486SX/20, with 4MB RAM, 200MB hard disk, VGA, DOS 4.01, $4,395. AST Research Inc., P.O. Box 19658, 16215 Alton Pkwy., Irvine, CA 92713-9658; 714-727-4141.

CIRCLE 714 ON READER SERVICE CARD

BENCHMARK TESTS: THE FIRST FOUR 486SX MACHINES

Intel claims that its new 20-MHz 486SX is up to 40 percent faster than a 33-MHz 80386 due to its 32-bit CPU core, 8K internal cache, integrated MMU (memory management unit) with paging, and more efficient one-cycle 32-bit instruction processing. However, even though our tests use 32-bit instructions, the faster operating speeds of the 33-MHz 386 and the 40-MHz AM386 propel these chips past the 486SX. That's because DOS's 8-bit addressing limitations cause overhead as instructions are sent in 8-bit segments and must be converted into 32 bits and then back to 8-bit segments.

The four 486SX machines tested here performed nearly the same. The Mitac 4270E's slower memory performance is due to 80-nanosecond page-mode memory that is not interleaved. The 486SX's internal cache compensates for this, so overall performance on our tests is not affected.



■ The **80486 and 80386 Instruction Mix** benchmark tests time a series of tasks specific to the processor. These tests show how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture.

■ The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

Performance Times (seconds)	80486 Instruction Mix	80386 Instruction Mix	Conventional Memory
ALR BusinessVEISA 486ASX	1.87	1.83	0.25
IBM PS/2 Model 90 XP 486SX	1.84	1.81	0.30
Mitac 4270E	1.81	1.78	0.41
AST Premium II 486SX/20	1.80	1.78	0.25
Compaq Deskpro 386/33	N/A	1.66	0.25
Compaq Deskpro 486/25	1.46	1.44	0.23
Bell Computer 386WB-40C	N/A	1.34	0.25

N/A—Not applicable: A 386 machine cannot run the 80486 Instruction Mix test.

TI's 16-ppm microLaser XL: Small Size, Low Price

HANDS ON
by Alfred Poor

If small is beautiful, then the Texas Instruments microLaser XL is gorgeous.

This 16-page-per-minute printer is rated for a heavy-duty 25,000-page-per-month duty cycle, but it comes in a remarkably small package. The price, too, is surprisingly small for a printer with such a high throughput: The base model comes with a list price of just $3,449.

The base model includes 512K of memory and HP LaserJet II compatibility. There is an "entry-level" PostScript model with 17 fonts for $3,999, and one with 35 fonts for $4,499. You can also start with the base model and upgrade to the other models for the difference in price: $550 for the 17-font PostScript, $1,050 for the 35-font versions. All PostScript prices include an extra megabyte of memory. The unit we tested was the 35-font model, which had an additional megabyte of memory installed. This configuration carries a list price of $4,844. All models come with just a parallel port; a serial port is available for $49, and a serial/AppleTalk interface costs $145.

The most noticeable feature of the printer is its small footprint. The entire unit fits within an 11- by 15.7- by 16.7-inch space (HWD), which is considerably smaller than most printers rated at about 16 ppm. In spite of its size, it still weighs a fair amount: more than 45 pounds. One way that TI manages this incredible shrinking act is by fitting the paper tray inside the case; nothing sticks out to take up more space.

Some compromises were made to keep the size small. The standard paper tray holds only 250 sheets—not much for a printer of this speed. There is an optional 500-sheet paper tray that sits under the printer, but it has a hefty list price of $495. Nevertheless, heavy-duty users may want to consider the additional paper-handling capacity, especially if the microLaser XL is to serve more than one user simultaneously.

The design requires that paper travel an S-shaped path from the paper tray to the face-down output tray. In testing, we found that heavy card-stock paper would not feed from the paper tray, but when fed through the manual feed slot, it printed fine.

The printer also accepted envelopes through the manual feed slot without a problem. There is a convenient face-up output tray as well, which combined with the manual feed provides a nearly straight-through paper path. TI specifies 16- to 24-pound paper for the input tray and 16- to 34-pound (including card stock) for manual feed.

The printer is fairly easy to set up and operate. It comes with the photosensitive drum already installed; all you have to do is add the initial charges of toner and developer. Unfortunately, the documentation goes short on installation, and the only instructions you have for this procedure are some cryptic icon illustrations on the side of the toner/developer cartridge. The printer would benefit greatly from a short "Read Me First" flyer to help new owners get started.

There is a 16-character LCD message window on the front of the case, plus 12 membrane buttons. These are well labeled and relatively easy to use, though it can get a bit confusing wandering through the different menu levels.

The manual contains excellent instructions for configuring the printer, complete with easy-to-read charts that help you find your way more easily. You can also print status pages, which provide plenty of detail about how the printer is configured. The only problem with the front panel is that the LCD window is difficult to read if you're standing next to the printer; you need to get down closer to its level to be able to read it clearly.

The microLaser XL performed well in our tests. Under HP emulation, it produced 14.2 pages per minute for text, and 2.6 pages per minute in our graphics speed test (22.9 seconds per image). Under PostScript, it was a bit faster at text with 14.6 ppm. The PostScript graphics test produced 0.6 graphics pages per minute, with an average of 98.1 seconds per image. (We discovered that if you run the text speed test over a parallel port using the interactive PostScript Executive mode, the page-per-minute result is cut nearly in half.) We encountered no compatibility problems in the testing, including the PCL torture-test pages. Printed images were crisp and dark, with only a slight fuzziness at the bottom of heavy black blocks.

One of the few disappointments was that the HP emulation mode offers only Courier and line printer fonts.

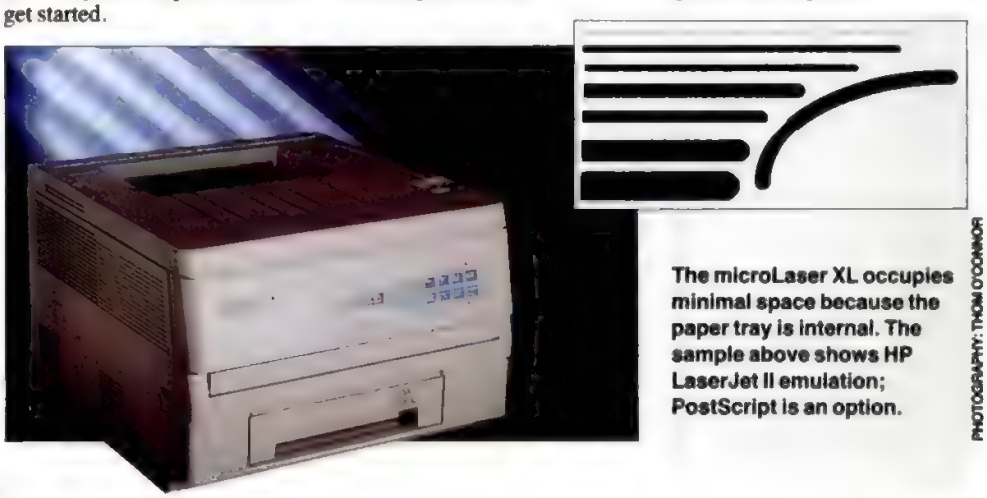
FACT FILE

microLaser XL
Texas Instruments Inc., Information Technology Group, P.O. Box 202230, Austin, TX 78720-2230; 800-527-3500.
List Price: With 512K and HP LaserJet II emulation, $3,449; with 1.5MB and 17-font PostScript support, $3,999; with 35-font PostScript, $4,499; 500-sheet paper tray, $495; envelope tray, $495; 1MB memory expansion, $345; serial port option, $49; serial/AppleTalk interface option, $145.
In Short: The TI microLaser XL sets a new low price point for high-speed, heavy-duty shared printers, while managing to package the unit in a surprisingly small case. Most users will need some of the options, such as the 500-sheet auxiliary paper tray, but even a fully configured model costs significantly less than competing designs.

CIRCLE 433 ON READER SERVICE CARD

The TI microLaser XL is an attractive alternative in the shared printer market, but the low cost of the base unit does mean limited features and small paper capacity. To get the full PostScript support with full paper capacity, extra memory, and additional interfaces, the list price swells to nearly $5,500, but this is still low compared with similarly configured competitors.

While it does not offer some features offered by others—network connections or duplex printing—Texas Instruments' microLaser XL is a suitable choice for many settings that require a shared printer. ■



The microLaser XL occupies minimal space because the paper tray is internal. The sample above shows HP LaserJet II emulation; PostScript is an option.

PHOTOGRAPHY: THOM O'CONNOR

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- ❑ Circus
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- ❑ Copperfield
- ❑ *Coronation Script*
- ❑ Corporate Condensed
- ❑ Courier
- ❑ Dateline
- ❑ Dateline Condensed
- ❑ *Diner Script*
- ❑ Don Casual
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- ❑ Futuri
- ❑ Garamand
- ❑ Garamand Condensed
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- ❑ Gettysburg
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- ❑ *Waldorf Script*

CIRCLE 299 ON READER SERVICE CARD

Requirements: IBM PC, XT, AT, PS/2 or compatible with 512Kb of RAM and a hard drive. HP Laserjet Plus, II, IIP, III, HP Deskjet or any Laserjet compatible laser printer. MS-DOS or PC-DOS version 3.0 or later. WordPerfect 5.0, 5.1 or later

Motorola's Wireless LAN Matches NCR WaveLAN's Speed over Shorter Distance

HANDS ON
By Steve Rigney

Motorola, the nation's premier two-way radio company, is channeling its expertise into Altair, a wireless LAN system based on what it calls the Wireless Inbuilding Network (WIN) architecture.

Even in this emerging technology, the company already has several competitors; Altair competes directly with NCR's WaveLAN (First Looks, May 14, 1991) and Telesystems' SLW ("The Next Wave: LANs Without Wires," May 29, 1990).

Altair operates at a frequency of 18 GHz (gigahertz)—an extremely high band, normally used for satellite communications—that benefits from being relatively free from interference and monitoring. By contrast, NCR's WaveLAN uses special modulation techniques to spread its signal across the more crowded frequencies near the cellular telephone band (a technique called *spread-spectrum broadcasting*).

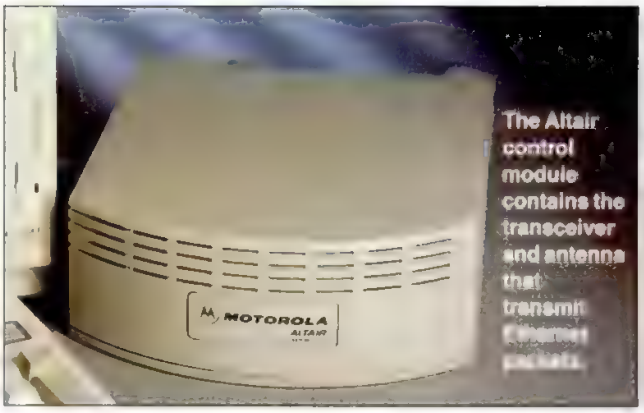
Altair's major distinction is its complete independence from LAN operating systems. Both NCR WaveLAN and Telesystems' ARLAN 450 reside inside a networked PC and require special software drivers for each operating system they support.

The Altair unit, however, attaches to the LAN cable and simply moves Ethernet packets. Altair works with any operating system that drives an Ethernet adapter board, including *NetWare, LAN Manager, LANtastic*, Unix, or VMS.

Altair's $7,490 list price buys the components needed to create a radio system to link two LAN segments, including thin Ethernet cable and terminator. This up-front cost is higher than WaveLAN's $2,780 entry cost, but Altair's cost per port drops to $715 in larger systems with 30 nodes connected by radio.

It takes less time to install the Altair wireless system than to explain: Picture two Ethernet LAN segments, one with as many as 33 nodes and the other as many as 7. One of the nodes on the larger segment is an Altair control module with built-in transceiver and antenna.

One node on the smaller LAN segment is an Altair user module. These transceiver and antenna systems move Ethernet packets between cabled LAN segments over radio waves. Up to five user modules, with as many as six attached computers or other devices, can communicate with one control module. The control module operates as an intelligent bridge reading the address of each Ethernet packet and routing it to the correct user module.



The Altair control module contains the transceiver and antenna that transmit Ethernet packets.

PHOTOGRAPHY THOM O'CONNOR

Using PC Magazine LAN Labs' benchmark test, we measured an average throughput of about 470K bits per second when a 386SX PC made requests of a *NetWare* 3.1 server over Altair. This is only slightly slower than NCR's WaveLAN and, for comparison, about the same throughput you would get from the hard disk drive of an AT-class PC. However, over a standard copper LAN cable connection, the same PC moved data with a sustained throughput of greater than 2 megabits per second. So both wireless LAN systems ask you to trade off throughput for flexibility and ease of installation, even though either system has adequate throughput for most offices.

The radio waves will travel up to 130 feet between the control and user modules if the path is clear. When a path is cluttered with obstructions, such as dry wall and office furniture, the range drops to 40 feet. The high-frequency signals used by Altair don't penetrate typical masonry walls. Because WaveLAN operates at cellular wavelengths, its signals easily pass through walls.

The Altair transmits at radiation levels well below the limits of both European and U.S. standards. Technically, you need an FCC license to have an Altair installation, but Motorola holds licenses around the country and coordinates your operation under its licensing arrangement.

An excellent alternative to wired LANs, Motorola's Altair doesn't offer throughput as fast as copper cable, but it is most certainly a worthy competitor for WaveLAN. ■

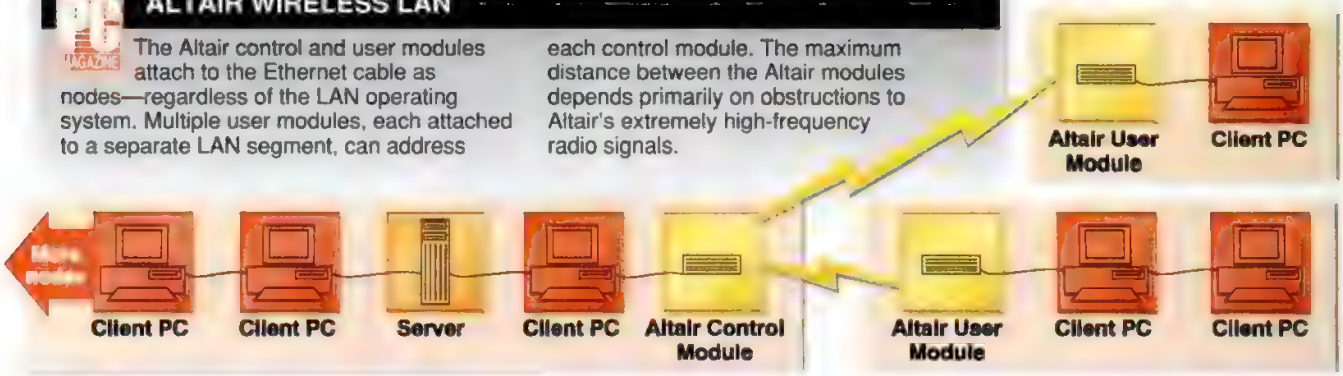
FACT FILE

Altair Wireless Ethernet
Motorola Inc., 3215 N. Wilke Rd., Arlington Heights, IL 60004; 800-233-0877.
List Price: Control module, $3,995; user module, $3,495.
In Short: Unlike other wireless LANs, Motorola's Altair works with any Ethernet network and LAN operating system to provide wireless connections between cable segments up to 130 feet apart. It gets high marks for ease of installation and has adequate throughput.

CIRCLE 432 ON READER SERVICE CARD

ALTAIR WIRELESS LAN

The Altair control and user modules attach to the Ethernet cable as nodes—regardless of the LAN operating system. Multiple user modules, each attached to a separate LAN segment, can address each control module. The maximum distance between the Altair modules depends primarily on obstructions to Altair's extremely high-frequency radio signals.



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Fiber-Optic Innovation: Plastic Cable Costs Less than Glass for Same Throughput

HANDS ON by Kimberly Maxwell

Fiber-optic networks—where data is transmitted as pulses of light—have represented a major step forward in building wide-area networks, and in bridging LANs.

Until now, fiber-optic networks for PCs have used strands of glass as the transfer medium; they've been expensive and they are difficult to install.

A plastic cable from Codenoll Technology and the Packard Electric Division of General Motors offers tremendous promise to save dollars and headaches in fiber-optic installations. Codenoll is marketing the product, while Packard Electric is actually manufacturing the cabling.

Codenoll's plastic cabling costs $1.45 to $2.10 per foot, while glass fiber sells for $100 for the first 8 feet, and $10 for each additional foot (these estimates were given by Raylan Corporation).

Connectors, devices that attach the fiber to the card, for glass fiber cost about $40, and there are hidden costs in the labor involved in installing the connectors. The installer must attend a special course to learn how to align and polish the cable ends.

Connectors for the plastic fiber cost less than $2 each and the installation tools consist of a pocket knife and a polishing wheel.

Codenoll's Plastic Fiber-Optic IEEE 802.3 Ethernet-compliant network system uses a star topology. The network is comprised of CodeNet cards attached to Multistar Hub cards, which are installed in a hub box (in this case called a Multistar repeater).

Prices for the CodeNet adapters start at $495 for an Optical Fiber Ethernet 8-bit ISA card. EISA Ethernet versions and Micro Channel versions sell for $1,295 and $795 respectively. The $495 hub card is installed in a $1,295 Multistar repeater, which can host 16 nodes.

All told, these figures translate to a starting price of about $1,071 per node. Glass fiber networks typically cost around $2,000 per node. But, while the two have fairly similar hardware costs; the dramatic price savings are in wiring and installation.

Codenoll's CodeNet cards emulate Western Digital's EtherCard Plus, but they look very different from standard network adapter cards. Each circuit card piggybacks a smaller daughterboard containing an optical transceiver and fiber-optic connectors.

Each also has a series of activity lights located on the card's back plate, and exposed on the outside of the PC. These assist in monitoring network activity. The cards come with network drivers for Novell *NetWare 286* and *386*, *DecNet*, *LAN Manager*, and *3+Open* networks.

The hub module interconnects LAN segments using different media into one central network. The star configuration is similar to the configuration of a 10BaseT network, making it very practical to mix network segments using plastic fiber and unshielded twisted-pair cabling.

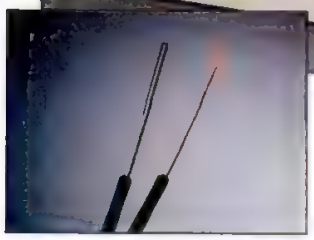
We installed a combination of plastic fiber-optic boards and traditional Ethernet adapter cards on one network using a Codenoll wiring hub. Using PC Magazine LAN Labs' benchmark test, we measured an average throughput of about 2 megabits bits per second when a 386SX PC made requests of a *NetWare* 3.1 server over Codenoll POF (Plastic Optic Fiber).

The speed of a glass fiber-optic network is similar to results we obtained with plastic.

Both glass and plastic fiber-optic network throughput times are slightly slower than the 2.1 megabits per second that the same PC hardware delivered when connected over thin Ethernet with 8-bit Western Digital LAN adapters. The software drivers for the respective networks could account for the difference in speed.

Fiber-optic networks don't transmit data any faster than networks using standard copper wiring such as coax or twisted-pair cabling. However, fiber-optic media doesn't absorb electrical noise from motors, radios, and neon lights, making them ideal for offices and factories with noisy electrical environments; and because fiber-optic impedance is a fraction of metal wire's, they're invaluable for linking systems across long distances. Finally because they don't radiate signals, fiber optic networks are more secure.

The benefits of fiber-optic networks are well known, but those advantages must be balanced against installation costs. Lower prices per node will obviously stimulate interest in the technology, and plastics make fiber optics look more appealing than ever. ■



Plastic fiber-optic cable is easier to install than glass. Codenoll's cable, connectors, and network card cost only half as much as glass.

FACT FILE

Codenoll Ethernet products
Codenoll Technology Corp., 1086 N. Broadway, Yonkers, NY 10701; 914-965-6300.
List Price: CodeNet ISA Ethernet card, $495; CodeNet Micro Channel card, $795; CodeNet EISA Ethernet card, $1,295; Multistar POF Modules, $495; Multistar Hub for 16 Multistar modules, $1,295; connectors, $1.95.
In Short: Codenoll's plastic fiber-optic cabling offers an easy installation, and is a low-cost alternative to glass fiber networks without sacrificing performance.

CIRCLE 704 ON READER SERVICE CARD

Quick, name the world's best memory manager:

NETROOM!

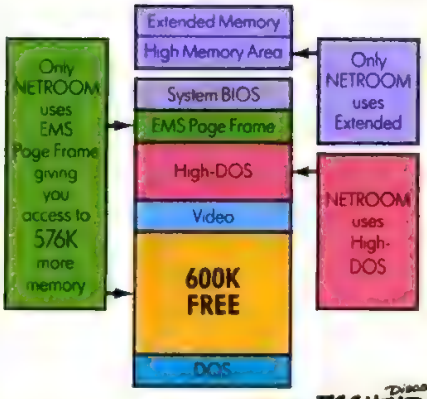
Right!

PC MAGAZINE EDITORS' CHOICE Jan 29, 1991

If you thought the answer is QEMM® or 386MAX®, think again. Because **NETROOM**® just beat them both, by winning PC Magazine's prestigious Editors' Choice award.

PC Magazine said† *"With its versatility, this $149 four-user version rates as a real winner. Considering NETROOM's price and capabilities, you will find that there is no second choice."*

What makes **NETROOM** a winner is that it is more than a great LAN manager. It is a full-featured memory manager that not only relocates LANs (like Novell, VINES®, etc.), it also moves device drivers, and TSRs into extended, expanded, and high-DOS memory.



Features:	NET-ROOM	QEMM	386 MAX
Windows 3.0 support	✔	✔	✔
Multiuser license	✔		
Converts Ext to Exp †	✔	✔	✔
Relocates to High-DOS	✔	✔	✔
Relocates to LIM 3 2 Frame	✔		
Relocates to Expanded	✔		
Relocates to Extended	✔		
Works on 386/486	✔	✔	✔
Works on 8088/286	✔		
Memory Analysis Utility	✔		

And, **NETROOM** is the only memory manager than runs on all PCs (8088 through 80486).

But, there's more...PC Magazine says it's *"The most flexible product we tested,"*...and... *"NETROOM uses a unique swapping feature to access data and programs in extended or expanded memory...Even PCs with tightly jammed high-DOS areas can benefit from the memory swapping capabilities of NETROOM."*

And to top it all off, with **NETROOM** you will get absolutely FREE—**DISCOVER**®, an excellent utility that makes installation a pleasure and provides a detailed, real-time view of the memory configuration and possibilities within a PC.

PC Magazine says *"Netroom's $149 price for four users is a steal."* So, go out and steal yourself a copy!

Available from Helix or at your local dealer.

Requirements: A 386, or some EMS 3.2 or EMS 4.0 memory hardware, or at least 64K ext. memory and DOS 3 3 or greater

†This feature not available on 286 machines.

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*Single User, 4 User $149, 10 User $249 plus $5 per order shipping & handling

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47-09 30th St., Long Island City, NY 11101 (718) 392-3100

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CIRCLE 313 ON READER SERVICE CARD

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Hayes' LANstep: Entry-Level OS Compares Well with LANtastic

Performance and Price Are Good; Unusual Interface a Drawback

HANDS ON
by Rick Ayre
and Ron Anderson

When you're late to the party you'd better make a grand entrance. At least that's what communications giant Hayes Microcomputer Products must have been thinking when it planned *LANstep*, its entry-level network.

Coming long after the establishment of *LANtastic*, Novell's *ELS*, and a half dozen other low-cost network solutions, *LANstep* is based on a non-DOS operating system with a somewhat nonstandard user interface that's distinctly different.

Hayes *LANstep* requires that its proprietary operating system be loaded on a network server, though not necessarily a dedicated server. Offering considerable flexibility, *LANstep* allows you to configure workstations either as *LANstep* workstations or DOS workstations.

A *LANstep* workstation boots to the server and runs in protected mode; a DOS workstation loads the network information from its own drive to access network services. DOS workstations can share printers, files, and programs but cannot broadcast their own local files over the network. *LANstep* also has a large appetite for system resources. On an IBM PS/2 Model 60 configured as a DOS workstation, the network OS occupies about 95K.

In a features comparison of entry-level LANs, *LANstep* fares well. Like most of the competition it provides for file and printer sharing, and both DOS and *Windows* applications can be shared from the server. It includes easy-to-use tools for adding applications, users, and stations to the network.

Hayes bundles LANstep Mail, a full-featured e-mail program, which includes the ability to create distribution lists, send registered mail, and attach files or whole directories to a message. With its built-in editor, LANstep Mail is an adequate system for most small networks. (An e-mail gateway is available as an option.)

LANstep's user interface is its most unusual feature. It uses doors with rooms as a metaphor to create what it calls "an office on your computer screen." Doors can execute a function, such as the DOS door, or provide an entry to an environment, such as the Mailbox door. The office serves the same function as the *Windows* Program Manager, but *LANstep*'s character-based icons make the interface seem somewhat primitive.

The icons can be manipulated with the mouse, or with function and cursor keys. Mouse actions are nonstandard. In conventional mouse parlance, where one click usually selects, and two executes, the *LANstep* office uses a left click to select and a right click to execute.

LANstep is particularly easy to administer. It doesn't require a dedicated network specialist to keep it running, and it provides an easy growth path to accommodate up to 128 simultaneous users.

Sharing, or "broadcasting" of applications, as *LANstep* calls it, is a painless procedure. Applications are installed on the server, where specified parameters allow user access to various files and applications. Users run applications by picking them from a broadcast list, or iconizing their favorite applications in a *LANstep* office menu.

LANstep supports all network interface cards compatible with the Network Driver Interface Specification (NDIS). The manual contains instructions for ARCnet, Ethernet, and Token-Ring implementations.

In a performance comparison, *LANstep* falls somewhere in the middle of its category. Performance tests were run using Ethernet cards, although the network was also tested using Token-Ring cards. *LANstep*'s throughput of 0.679 kilobits per second running on a 386 server, is a bit less than the 1.27 kilobits per second throughput of the DOS-based *LANtastic* network, and considerably less than the 2.5 kilobits per second you get from *Advanced NetWare* in a similar configuration.

Still, for day-to-day network operations such as running applications from the server and printing to shared devices, the performance seems adequate.

In a price comparison, *LANstep* holds its own. A five-user *LANstep* operating system license priced at $595 translates to about $119 per node. Since five-node upgrades are $395, a ten-node version can be had for $99 a node.

ReadyLINK (First Looks, February 26, 1991) in a similar configuration costs a little under $130 per node and *LANtastic* software sells for $99.

LANstep's non-DOS-based approach and its unusual interface offer a mixed bag. The proprietary OS provides a measure of added security, efficient one-station administration, and an easy expansion path. The hardware requirements are demanding. In a world where DOS-based low-cost LANs have become increasingly refined, it'll be a challenge for Hayes to carve a niche for a proprietary network OS. ■

LANstep uses a door and room metaphor as the front end to its proprietary network OS.

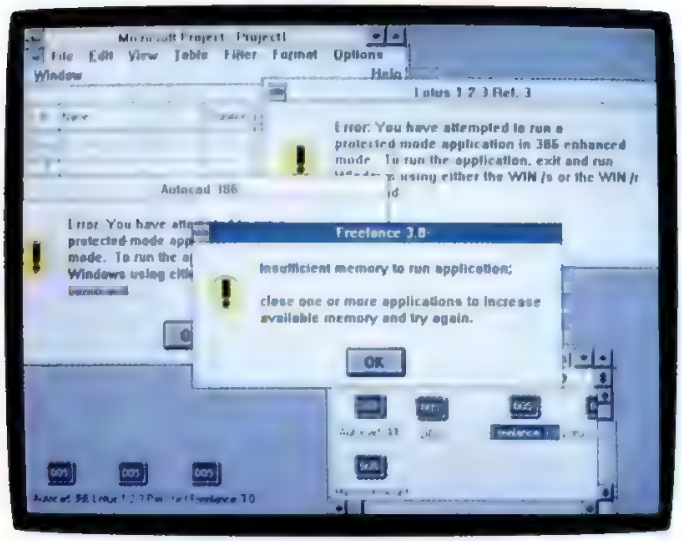
FACT FILE

LANstep
Hayes Microcomputer Products Inc., P.O. Box 105203, Atlanta, GA 30348; 404-441-1617.
List Price: Five-node starter kit, $595; $395 for each step expander.
Requires: For network software server: 286-based PC or better, 20MB hard disk, 1.5MB extended memory, network card. *LANstep* workstation: 286-based PC or better with 1MB extended memory, network card. DOS workstation: 8088-based PC or better, network card.
In Short: An entry-level network OS with more than entry-level features. *LANstep*'s hardware demands are steep, and its interface is easy to master yet non-standard.

CIRCLE 702 ON READER SERVICE CARD

Is Windows 3.0 the end of DESQview™?

Not if you're still using DOS programs.



Windows 3.0. The multitasking, windowing environment.

DESQview 386 2.3. The multitasking, windowing environment.

Are you still using MS-DOS programs on your PC?

You may want to use DESQview as your primary operating environment.

The new DESQview 2.3 and DESQview 386 2.3 let you use your favorite DOS and DOS-extended programs in windows side-by-side on 80286, 80386 and i486 PCs. As you can see above, you can even run Windows programs within DESQview 386. So the next time you get error messages like the ones at the left in Windows, remember how the same set of programs look running in DESQview.

Whatever standard you use—DOS, extended DOS or Windows—DESQview is still the best way to get the most out of the hardware and software you own today.

DESQview. The obvious choice.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (213) 392-9851 Fax: (213) 399-3802

This comparison was made using a system like the one you might run: Both shots show an ALR FlexCache 33/386 running DOS 3.3 with VGA display adaptor, Novell NetWare v3.01 Rev. A, with IPX/SPX v3.01 Rev A, Microsoft Mouse 7.00, and Microsoft SMARTDrive v3.03 disk cache. Buffers were set to 20. For the Windows screen, we ran Microsoft Windows 3 HIMEM.SYS and EMM386.SYS. For the DESQview screen, we ran QEMM 386 v5.1.

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CIRCLE 338 ON READER SERVICE CARD

Harvard GeoGraphics' Maps Link Regions and Statistics

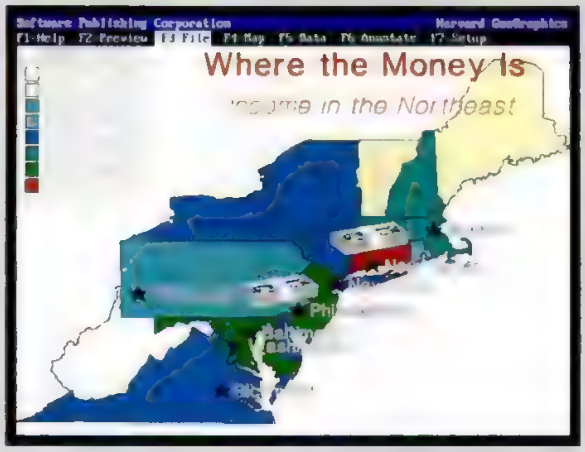
HANDS ON
by Robert Kendall

Conventional charting packages are great for conveying numerical and textual facts, but for geographical information, there's no substitute for a map.

Enter *Harvard GeoGraphics*. This $395 mapping package from Software Publishing Corp. can enhance presentations with annotated, custom-made maps of any place in the world. You can even shade different map regions according to linked data values.

A separate program from *Harvard Graphics*, it will export images in *Harvard Graphics'* .CHT format, so maps can be used in a presentation.

Harvard GeoGraphics is built upon a map library that covers every country and includes over 3,000 cities. For domestic mapping, you get state and county borders, plus the locations of more than 63,000 American cities as well. There are also crude representations of three-digit ZIP code areas.



GeoGraphics can establish a relationship between data in a .WK1 file and the colors used in a map region.

The control the program gives you over vast geographic resources is what makes it a winner. Decide which scale you want to work on—international or U.S. divided into state, county, or ZIP code area—and then select the regions you want. They fall into place like pieces in a jigsaw puzzle, and with each addition the map resizes to fill the screen.

To pick regions for your map, you can scroll through a list of countries, states, counties, or ZIP codes, or just type in the name. You can also add regions in groups, such as all the Mid-Atlantic states, OPEC nations, or counties in Tennessee.

Adding cities is a similar process of picking them individually or by group. Unfortunately, there's no easy way to combine different types of boundaries (such as state and county) in one map, and you can't establish new boundaries.

Once you've pieced together your map, you can customize the cartographic details. You can display labels; although in their default settings labels may overlap or extend off the screen. Fortunately, you can adjust label sizes and colors en masse or solo and can reposition labels for cities, but not regions.

For polishing, you can add titles and text annotations, though you have only one font in a few styles to choose from. You can also add clip art from the tiny library included or from the *Harvard Graphics* library.

One of the most powerful features of the package is its thematic mapping capability: Regions can be shaded to reflect data ranges. Just type the data in manually or establish a live link to an ASCII or .WK1 file and then assign different colors and fill patterns to different ranges.

The program can create up to 16 thematic ranges. You can create or modify ranges manually, as well as customize the automatically generated legend.

GeoGraphics has no drawing tools, but if you want to jazz up your maps you can export them to *Harvard Graphics* or turn them into PCX or EPS files. *Harvard GeoGraphics* supports a wide range of output devices, and it produced attractive LaserJet output in our testing, smoothly converting screen colors to dithered patterns.

The package has a few liabilities. It displays maps using the standard Mercator map projection, which is good for a world scale but results in distortion if you're mapping a single country. You can't zoom in on areas. You may also run into a memory ceiling with a complex map.

GeoGraphics uses an idiosyncratic menu structure that's similar to *Harvard Graphics*, and the two work well as companion products. If you're already comfortable with the *Harvard Graphics* approach, *GeoGraphics* may be just the tool you need to enhance your presentation graphics arsenal. ■

GEOGRAPHICS: The Middle Ground in Mapping Software

by Gus Venditto

Harvard GeoGraphics has some similarity to high-end mapping programs, but it doesn't venture too far into the territory.

GeoGraphics is more advanced than the $149 clip-art library that Software Publishing sells for *Harvard Graphics* and that Lotus sells for *Freelance*, since *GeoGraphics* lets you establish live links between data and map shading.

But *GeoGraphics* does far less than a program like *Atlas*GIS*, a leader in the field of geographic information system (GIS) software. *Atlas*GIS* (Strategic Mapping, San Jose, Calif.) reads map coordinates from ASCII or database files to draw maps to describe any location on the planet; compatibility with Census Bureau formats means you can generate a street-map for any town in the U.S. and correlate it to demographic data.

Don't hold that against *GeoGraphics*; it costs $2,100 less and is designed to make geographical presentations more accessible.

A feature story about Atlas*GIS and other high-end mapping programs will appear in the July issue.

FACT FILE

Harvard GeoGraphics
Software Publishing Corp., 1901 Landings Dr., P.O. Box 7210, Mountain View, CA 94039; 415-962-8910.
List Price: $395.
Requires: 512K RAM (640K on networks), hard disk, graphics display, DOS 2.1 or later.
In Short: Mapping for the rest of us, *GeoGraphics* uses simple pick lists to build attractive maps, both U.S. and international.

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— *PC Magazine*

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***PC Magazine*, "Out of 104 machines from 58 companies...For Overall Excellence we selected ZEOS International..."**

***InfoWorld*, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent."**

***Government Computer News*, "Arguably the fastest MS-DOS and OS/2 micro in the world."**

***PC Resource*, "ZEOS ...provides quality comparable with IBM or Compaq and does so for about 70% of the price."**

***PC Magazine, Editor's Choice*, "The ZEOS blows away every other computer...a smart choice."**

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PC MAGAZINE

EDITOR'S CHOICE

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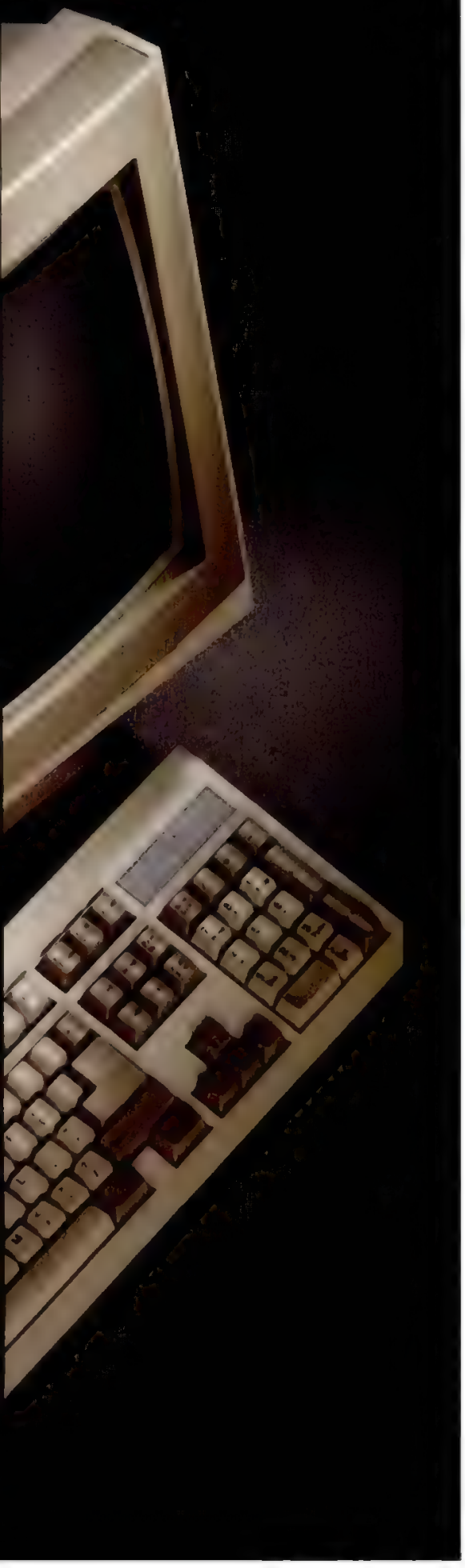

ZEOS 386

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Sim

the E

CACHE MEMORY MEANS PERFORMANCE!

That's why each and every ZEOS '386DX system has a minimum of 64K SRAM Cache standard; *our 33MHz screamers come standard with a 128K Cache.* Having an on-board memory cache is important in realizing the full potential of any '386 processor. That's why only low end '386DX systems are sold without a Cache. That's why ZEOS gives you a Cache, and all the extra performance that comes with it!

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Speaking of speed. Standard in your new ZEOS '386 will be one of our *incredibly fast* 85MB or 130MB IDE hard drives. These babies were designed for the '386 and they come packing all the speed you'll need. Like *PC Magazine* said, ZEOS designs for speed. And for Quality Too.

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You'll especially like the value you find in our money saving ZEOS system packages. And when you opt for any package with 4 Megs of memory, we also include the new version of Microsoft®

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ZEOS IS THE LEADER

10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but *seven* times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

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Reason #4

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Reason #5

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ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

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ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

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Caere Typist Puts OCR in the Palm of Your Hand

HANDS ON
by Lori Grunin

If anyone could change hand scanner–based OCR's bad reputation it would be Caere Corp., makers of the most accurate OCR software on the market. And the company's $595 Typist, a 300-dot-per-inch hand scanner with the OCR smarts built-in, certainly reflects the years of work that Caere put into refining their Anyfont recognition algorithm. Unfortunately, however, the product is still a hand scanner, and performing a relatively straight scan at a consistent speed is a deceptively challenging feat.

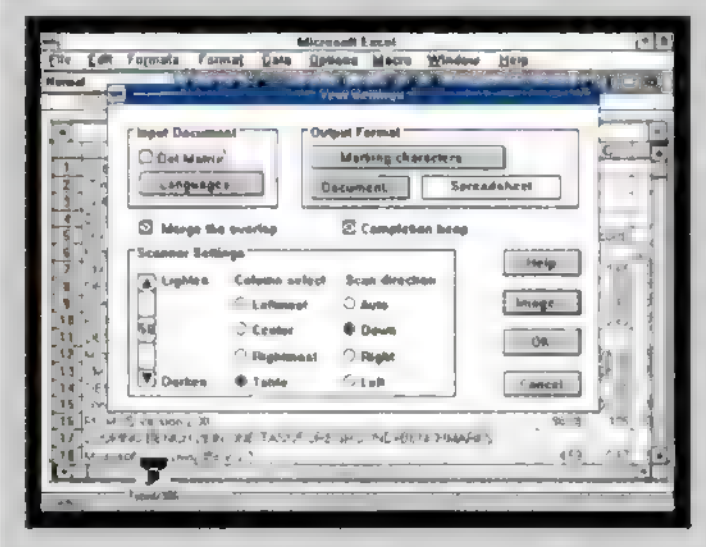
Typist is unique among OCRs in one respect: When performing recognition, it stuffs the keyboard buffer with text so that the text streams directly into whatever application you have open, under both DOS and *Windows* 3.0.

The DOS version runs as a TSR (it uses approximately 145K with the pop-up settings menu, or 103K without). The OCR unit is always on; with your application in text-entry mode, you merely press the scanning bar and scan. When you release the bar, recognition commences (you are kept apprised of its progress by a status bar) and the text pours into the application as if typed by a phantom super-secretary. You can also scan the text into the package's small ASCII editor.

Before scanning you can set brightness, direction, input quality, language, and output document type. You can also scan columns that are close to a binding or for table scanning.

When combining multiple scans, Typist will only pass on the differential text. In addition, Typist supports four dithering patterns, and can output TIFF and PCX files.

The scanner unit, which comes with an interface board and drivers, operates similarly under *Windows* as a concurrent application. You are also treated to random displays of the text bitmap during recognition. For any *Windows* application that doesn't work directly with Typist, you can scan the text into the clipboard and paste it into the application later.



Typist is a unique hand scanner because it scans text directly into your application.

Recognition occurs quickly, although this shouldn't be terribly surprising given the fully loaded hardware platform that the product requires: a 386SX-based PC or better with at least 4MB of memory (under DOS, 2MB must be configured as *extended* memory using a VCPI-compatible extended memory manager).

Getting an adequate scan proved trying. There's no way to preview scans, which makes finding the appropriate brightness setting difficult. Any character whose shape is sensitive to scanning speed, such as the letter *s*, gave Typist problems. If the scan wasn't very good, Typist would chew on it for a while and give a completion beep, but nothing would appear in the application.

If you have occasional OCR needs and you have your heart and pocketbook set on a hand scanner, Typist is the best alternative. All you need is a steady hand and a smooth stroke. ■

List Price: Typist, $595.
Requires: 4MB RAM, 386SX-based PC or better, *Windows* 3.0 or DOS 3.1 or later. Caere Corp., 100 Cooper Ct., Los Gatos, CA 95030; 408-395-7000.

CIRCLE 710 ON READER SERVICE CARD

$99 Laptop Tool Cuts Dead Weight From Worksheets

HANDS ON
by Craig Stinson

Lotus 1-2-3 users who travel with low-capacity laptops need to keep their worksheets lean. *The WorkSheet Optimizer*, a $99.95 add-on from Brubaker Software, is just the thing. Depending on the contents of your worksheet, it can reduce RAM and disk usage by 50 percent.

The WorkSheet Optimizer (*WSO*) reduces the size of *1-2-3* (Releases 1A and 2.*x* only) and *Symphony* files. It removes obvious dead weight, such as null labels and formatted but empty cells. If spelled-out macro commands are used, it abbreviates them ({right} will become {r}). If you've rendered any range names invalid, *WSO* removes them from the range-definition table.

WSO scans and simplifies each formula. Parentheses that don't affect a cell's outcome are removed; so are unnecessary plus and minus signs. Formulas that don't reference other cells become constants. Any double-precision real numbers that have integer values are replaced with true integers.

WSO even looks for occurrences of two or more formulas incorporating a common expression. For example, if the formulas in C1 and D1 are 2*A2/A1 and 3*A2/A1, respectively, the program looks for another cell that consists only of the expression A2/A1. If it discovers such a cell, it then replaces each appearance of A2/A1 with a reference to the single cell. If no such cell exists, *WSO* creates it in an unpopulated region, formats it as Hidden, and substitutes references to the new cell for each instance of the expression.

Finally, the program will offer to remove all parentheses from all formulas, in effect changing *1-2-3*'s formula notation from infix (algebraic) to Reverse Polish. You may not be able to decipher the results, and you won't be able to edit formulas without restoring the parentheses manually, but your worksheet will recalculate faster and take up less space.

If all this sounds like a radical and dangerous way to lop the fat off your worksheets, you're completely right. *WSO*, in effect, reduces your models to runtime versions, removing any "self-documentation" built into the formulas. Fortunately, all reducing measures are optional. Moreover, the program preserves your originals giving you distinctly named copies, including a backup of your original and a text file detailing its changes. Finally, Brubaker Software supplies a simple macro that can restore any cell on the optimized worksheet to back its original form.

Because each optimized file spawns three new files (the backup, the report, and the optimized version), *WSO* is self-defeating as a means of conserving desktop hard disk space. But it's an effective way to turn overweight models into trim traveling versions for laptops. ■

List Price: *WorkSheet Optimizer*, Version 1.1, $99.95.
Requires: 320K RAM, DOS 2.1 or later. Brubaker Software, 606 Carrolton Blvd., West Lafayette, IN 47906; 317-497-2928.

CIRCLE 431 ON READER SERVICE CARD

Latest Attempt to Run Mac Software on a PC Falls Short

HANDS ON by Steve Rosenbaum

Hydra Systems has a board that can have your PC running Macintosh apps in less than an hour, and at a cost of only one slot and slightly over $1,000. But you've got to be willing to persevere with an unpolished product that needs additional software and hardware development before it becomes a plug-and-play solution.

The $995 Hydra One is a Macintosh-compatible computer running on a full-size ISA PC plug-in board. It runs most Macintosh software on any PC equipped with a standard slot, a hard disk, EGA or better resolution, and a mouse. Using a 125K TSR program to hotkey between PC and Mac modes, this virtual Mac uses your existing keyboard and mouse for input, and displays its output on your existing screen.

For disk storage, the board can use its own external SCSI drive, a disk image that you set up as a file on your PC's hard disk, or a combination of both. And with its on-board SCSI port and RS-422 serial port, the Hydra can link to most common Mac peripherals.

The virtual Mac runs as an independent coprocessor at a respectable 16-MHz. Tests using *Microsoft Excel* showed the Hydra to be about 1.5 times as fast as a Mac Classic for calculations. But disk access through the simulated disk image on the PC hard drive was noticeably slower than equivalent operations directly from the PC host.

Because they are independent processors, both the PC and the virtual Mac continue to run in the background until they need access to peripherals. Live applications on either machine often survive crashes on the other. Eventually, Hydra plans to add a disconnect/reconnect function and a re-entrant RAM-resident driver, allowing full independent software operations.

Currently, the Hydra arrives minus ROM and RAM. You have to scrounge your own Apple 128K ROM chip set from one of the companies that gets them from junked Macs (prices average about $100). You also need to add 2 or more megabytes of standard Mac-style SIMMs ($50 to $150 per megabyte). Hydra promises its own ROM set shortly; the company claims this will be done properly to withstand any possible legal challenge from Apple.

The Hydra package includes only some of the software you'll want: a copy of *Word for Word/Mac*, a translation program for word processing files, and On-Track Computer System's *Disk Manager Mac* for formatting Mac drives. Right now the Hydra One can only transfer an entire Mac disk to and from a disk image on the PC hard disk. Until Hydra completes other utilities, you are relegated to either using a network or running a serial link between the Hydra and the PC host for exchanging files between the Hydra One, the PC, and a Macintosh.

True Macaholics, intrepid explorers, or those inextricably caught between computing cultures, won't let the limitations of this early release stand in their way. Those who distrust too many loose ends might want to wait. ■

List Price: Hydra One, Version 1.0, $995. **Requires:** ISA bus, 2MB to 4MB RAM, hard disk, one of several supported 3.5-inch floppy disks, Apple ROM chips, EGA or better resolution, Microsoft mouse or compatible. Hydra Systems Inc., 20863 Stevens Creek Blvd., #330, Cupertino, CA 95014; 408-996-3880.

CIRCLE 430 ON READER SERVICE CARD

Logitech's TrackMan Portable Challenges Microsoft BallPoint

HANDS ON by Robin Raskin

At first glance, Logitech's $169 portable pointing device, the TrackMan, seems like a knock-off of Microsoft's highly publicized BallPoint (First Looks, May 14, 1991). On closer inspection, though, it's clear that the TrackMan has the more radical design, since it's used vertically—a novel position for pointing.

Like the BallPoint, the TrackMan is a mouse turned over. The oval-shaped unit is slightly larger than the BallPoint. It has a small trackball in its middle, and three buttons: a main button on the unit's rim, and two positioned above and below the ball.

These correspond to the buttons on a three-button mouse. The BallPoint has four buttons flanking a trackball; it's a two-button mouse with the extra two buttons used for drag lock.

You cup the TrackMan in your hand and use your thumb to roll the trackball. Your index finger clicks the main button, and your thumb clicks the secondary buttons. The thumb/index finger combination works well, but will soon make you feel as if you've been thumb wrestling. The BallPoint has you use your index finger to move the trackball, with your thumb and middle finger managing the mouse clicks—an equally tiring position.

Logitech's TrackMan gets your thumb to control the on-screen pointer. Microsoft's BallPoint has your index finger move the trackball.

PHOTOGRAPHY: THOM O'CONNOR

The TrackMan adapts well. The main mouse button that spans the cusp of the unit can be detached and flipped, and the wire to the serial port can be rerouted for left-handed use. It can be used as a freestanding device that sits in a vertical orientation; it can be attached to the side of a laptop using a spring-loaded clip; or it can be held in your hand.

In lieu of spring-loaded clips, Microsoft makes use of thumbscrew-fastened clamps to attach the BallPoint to a laptop. The technique requires a bit more fiddling but is sturdier. You can easily dislodge the TrackMan from its spring clip or close your laptop's cover with the TrackMan still attached.

When you attach the unit to a laptop, the TrackMan's angle of attachment is fixed at a 45-degree angle. The BallPoint's attachment angle is variable; you can tilt the device until it feels comfortable.

Despite the attention to design, portable pointing remains frustrating for those used to using a standard mouse. If you must point on the road, you should try both devices before making a decision. ■

List Price: TrackMan Portable, $169. **Requires:** Available serial port. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 415-795-8500.

CIRCLE 706 ON READER SERVICE CARD

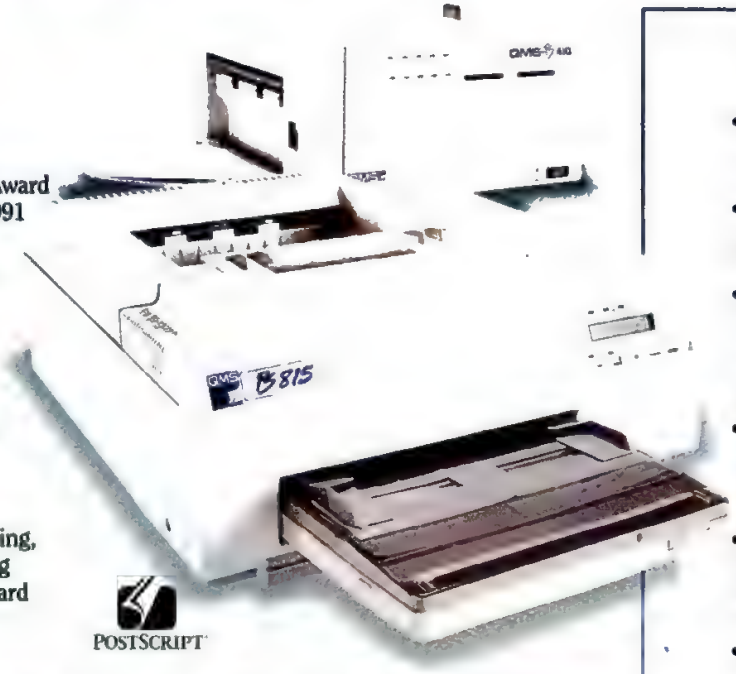
Our Latest PostScript Printer Technology Impressed The Experts...

MacUser, Editor's Choice Award (Eddy), Jan. 9, 1991

PC/Computing, Most Valuable Product, Nov. 1990

BYTE, Editor's Product Merit Award, Jan. 1991

Personal Publishing, 1990 Outstanding Achievement Award



POSTSCRIPT

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- ESP - Emulation Sensing Processor (printer interprets incoming printer language and switches automatically)
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Before we developed the QMS-PS® 410 four page-per-minute laser printer, we performed one very important task. We listened to what you wanted. Then we engineered a printer light years ahead of the rest with features that aren't available on other printers at any price.

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*patent pending

CIRCLE 164 ON READER SERVICE CARD

ReadRight for Windows Falls Short in OCR Competition

HANDS ON
by Barry Simon

OCR Systems has moved its *ReadRight* optical character recognition software to the *Windows* environment, and revamped its recognition engine at the same time. The $495 package provides an economical alternative to the market leaders *WordScan Plus* and *OmniPage Professional*, which cost about twice as much. However, it falls short in accuracy and speed.

Like the other programs, *ReadRight for Windows* is an Omnifont program. It uses recognition techniques based on topological properties, so that it need not be trained for particular fonts. It supports the main brands of page scanners, including Canon, Chinon, HP, and Microtek and will also use TIFF and PCX files.

ReadRight will do its best to decompose a page. If it has trouble with difficult pages, for example multicolumn pages, you can preview a "greeked" image on-screen, mark regions with a mouse, and then decompose the separate regions. There is also a template feature to handle situations where you are processing multiple pages with the same layout.

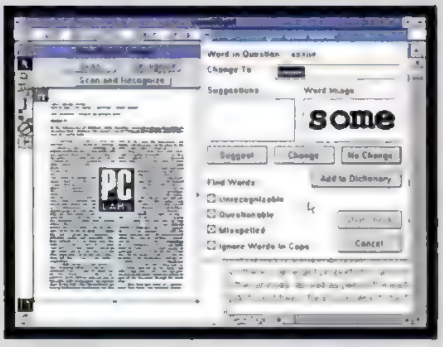
After scanning the text, *ReadRight* will run through the result, displaying characters it was unsure about or words not in its spelling dictionary. You cannot edit instances where the program made an error but didn't recognize it as one. This is particularly bothersome in places where some excess spaces were introduced, as happened repeatedly with the program mistaking a double "l" as "l" followed by a space followed by the numeral one.

ReadRight's spell-checker does not seem especially tuned to OCR work either. For example, it misread "geese" as "qeese"; its spell-checker could suggest no alternative.

WordScan Plus takes roughly twice as long to scan a document as *OmniPage* or *Recognita*, but it is still speedy compared with *ReadRight*. On comparative samples, *ReadRight* took almost exactly twice as long as *WordScan Plus*, four times as long as the other two packages. For example, a 12-point Times Roman page took a full 5 minutes to scan and recognize.

The accuracy level was acceptable, but certainly not on par with *WordScan Plus*. *ReadRight* had significant trouble with underlined Courier, and in general it produced anywhere from two to fives times the number of errors as *WordScan Plus* on typical documents.

ReadRight has the price advantage over the market leaders, but has serious disadvantages in speed and accuracy. ■



ReadRight's error corrector looks for unrecognized and questionable letters and misspelled words.

List Price: *ReadRight for Windows*, $495. **Requires:** 3MB RAM free after *Windows* has loaded, *Windows* 3.0. OCR Systems, 1800 Byberry Rd., #1405, Huntingdon Valley, PA 19006; 215-938-7460.

CIRCLE 434 ON READER SERVICE CARD

Get Groups on Schedule in 38K

HANDS ON
by Barry Simon

Setting up a meeting in a busy office can often take up more time than the actual gathering. Networked PCs provide part of the solution. What's been missing is the right software. *SuperTime* handles group scheduling and links the schedules to an electronic mail system.

A supervisor creates a list of users and resources; the list can include supersets such as departments and groups of individuals. Someone interested in convening a meeting chooses the people and resources from an on-screen pick list; they ask *SuperTime* to find an available time slot.

A message is then sent automatically to every person that is on the list. Options allow you to ask for a confirmation, or, in a bolder move, to place the meeting time on the recipient's calendar.

Recipients can stay completely informed about impending meetings in three ways: by running *SuperTime* as an application and then shelling to DOS to run other applications, by running *SuperTime* as a TSR, or by receiving a message via MHS message services. When run as a TSR, *SuperTime* requires 30K.

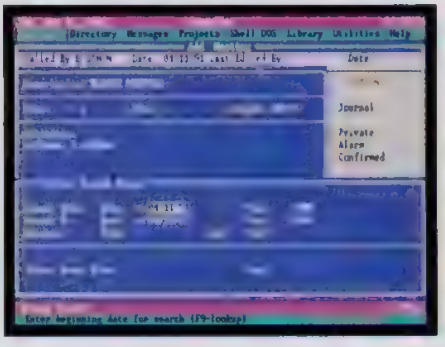
A few keystrokes allow the recipient to transmit an acceptance or a decline to a meeting. The meeting's initiator can check for the status of replies, and if there is a need, reschedule the meeting.

Privacy is maintained via a password system.

SuperTime offers an impressively rich array of features that extend its value beyond conventional group scheduling: There are shared and private to-do lists, a calendar, an address book, and also a calculator. There are even some primitive project management tools including Gantt charts.

Surprisingly, even though it supplies electronic forms to take phone messages, there is no automatic phone dialer. The hotkey cannot be changed from Alt-F3 and the help system is not very helpful.

However, these shortcomings shouldn't stop a LAN-based DOS workgroup from considering *SuperTime* as the central component of a computerized group-wide organizer. ■



Setting up meetings in a networked environment is *SuperTime*'s most central function.

List Price: *SuperTime*, Version 1.0, single-user version, $295; variable per-user costs to $89 per user for over 100 users. **Requires:** 512K RAM, network complying with DOS 3.*x* file locking, DOS 3.3 or later. SuperTime Ltd., 2025 Shephard Ave. E., #2206, Willowdale, Ontario, Canada M2J 1V7; 416-499-3288.

CIRCLE 701 ON READER SERVICE CARD

The 11" x 17™ PostScript Powerhouse Just $9995!

PC MAGAZINE EDITORS' CHOICE November 13, 1990 QMS PS 2210

POSTSCRIPT®

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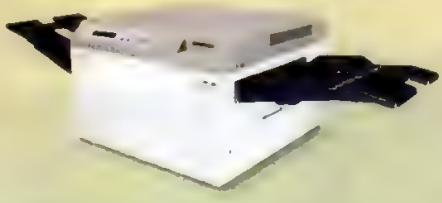
The QMS-PS 2210 is perfect for a shared printer environment requiring high-quality 11"x17" output. Whether you use Macintosh® computers, IBM®PC's /compatibles or most other mini computers and mainframes, you'll enjoy instant connectivity with AppleTalk®, RS-232 serial and Centronics® parallel interfaces. Should you require non-PostScript printing applications, the 2210 comes standard



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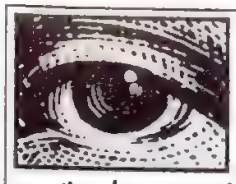
CIRCLE 141 ON READER SERVICE CARD



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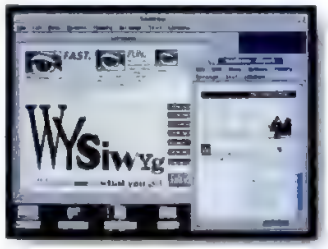

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PC Computing

[GeoWorks] has produced a GUI capable of making the PC a more friendly and powerful creature to the millions of people Windows and OS/2 have left behind...
FIRST LOOKS, PC Magazine

[PC/GEOS] thrives in a 640K 286, and even performs respectably on an 8088. On a run-of-the-mill 386, [PC/GEOS] peforms crisply in a way that Windows only dreams of...
PC Magazine

GeoWorks PC/GEOS: What Windows 3.0 Should Have Been.
INFO WORLD

The Geos environment sports a simplified (but sharper-looking) Windows-like interface with many of the same features, comes with Ensemble (a bigger and more capable suite of applications), and runs lickety-split on 80286s and XTs.
PC WORLD

A professional image for the small office.

For the small office, there's nothing better than GeoWorks Ensemble because it comes complete with everything you need to look your professional best.

With GeoWorks Ensemble, reports look published, memos seem majestic, and even simple Fonts, formatting, virtually everything is automatic with Ensemble. There's really nothing easier.

Imagine what that special client will say when your next report looks like this. Imagine how fast people will pay your bills when they look

ce, Starting With The Way You Print.

next creation while the first smoothly prints in the background. Or you might check out one of the many other applications included in Ensemble, like GeoManager,™ a graphical file manager, GeoDex™ an electronic address book, GeoPlanner,™ a calendar/schedular, America Online,® an easy to use electronic mail and telecommunications service connecting you to thousands of PC users

and a wide variety of information services; or the calculator, notepad, banner maker, and solitaire game, all included in the Ensemble package.

Hard to believe, right? State-of-the-art performance on your existing PC? Maybe that's why Ensemble has won so many awards in its first few months. But don't take our word for it, check out what the industry experts are saying (we printed a few quotes above). Or take us up on our Working Model offer, so you can be the judge.

GeoWorks Ensemble, because performance is defined as much by the software in the PC as the hardware it runs on.

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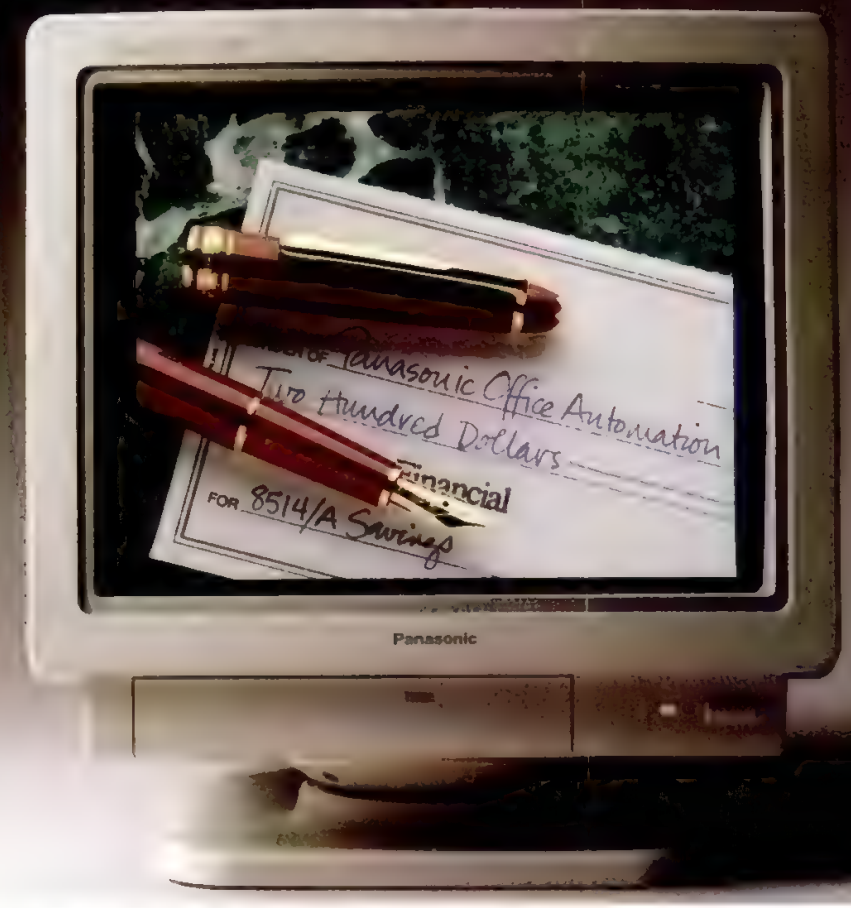
CIRCLE 252 ON READER SERVICE CARD

Introducing the PanaSync™ C1381 Monitor.

8514/A resolution. VGA® price.



If you want the ultimate VGA graphics standard, and you've resigned yourself to paying a premium of hundreds of dollars to get it, you'll find our newest monitor pleasant viewing indeed.

The PanaSync C1381 gives you a sharp 1024 x 768 pixels, with 0.28 dot pitch. And virtually infinite color resolution.

It's compatible with the most popular VGA boards, as well as analog RGB, MCGA, SuperVGA, and — of course — 8514/A standards.*

It's comfortable in virtually any IBM-compatible or Mac II environment.**

And it's a masterpiece of ergonomics. With front-mounted controls, tilt/swivel stand, plus a non-glare tinted black-matrix screen.

All this at a suggested retail price comparable to many of the ordinary VGA monitors on the market right now. For more information, simply call toll-free **1-800-742-8086.**

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Panasonic
Office Automation

PanaPro™ Monochrome Desktop Publishing Monitors with Video Adapters.

(Mac SE) (Mac II) (IBM XT/AT & PS/2 Model 30)

PanaSync™ Multiscanning Color Monitors.

CIRCLE 746 ON READER SERVICE CARD

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*** IBM XT, AT and PS/2 are registered trademarks of International Business Machines Corp. Macintosh is a registered trademark of Apple Computer Inc. An optional cable is required for Macintosh.*

M3-PC

by
Cristina Córdova
and Nate Zelnick

New & Improved

News of Announced Products and Upgrades

Baler ICE Adds Custom Menus, Macros, and Security to 1-2-3

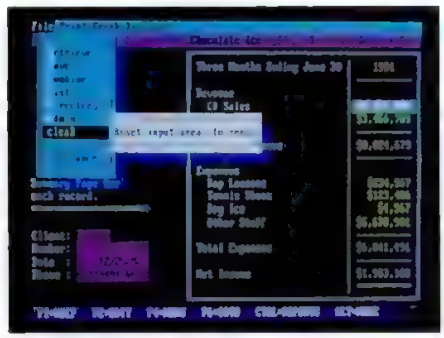
NEW **Baler Software**, known for its spreadsheet compiling software, has developed an add-in application construction program for *Lotus 1-2-3*, Release 2.2. The $395 program, *ICE*, adds customization, security, and distribution capabilities to *1-2-3* worksheets.

With *ICE*, users can add pull-down or pop-up menus and create context-sensitive help for spreadsheets, as well as lock worksheets to avoid unwanted changes. In addition, Baler has extended the *1-2-3* macro language by adding 70 new advanced macro commands to the standard 49. *ICE* also offers four worksheet menu styles.

With royalty-free distribution of a runtime version, users who do not own the *1-2-3* add-in can still use *ICE 1-2-3* worksheets.

List Price: *ICE 1-2-3*, $395. **Requires:** 75K RAM, *Lotus 1-2-3*, Release 2.2 or later, DOS 2.1 or later. Baler Software Corp., 1400 Hicks Rd., Rolling Meadows, IL 60008; 708-506-9700.

CIRCLE 441 ON READER SERVICE CARD



Baler's *ICE* adds 70 macros to the *1-2-3* macro language.

Orchid's Baby AT-Sized System Board Uses AMD's 40-MHz AM386

NEW Since Advanced Micro Devices' (AMD) announced its 40-MHz AM386 processor, a surge of companies have been racing forward with products based on the new chip. Chips and Technologies is introducing a 40-MHz version of its PEAK/DM 386 processor. Cube Computer Corp. is adding a 40-MHz 386 to its Plus systems line, and Cyrix Corp. is working on a math coprocessor for the chip.

Orchid Technology joins the race with its new Privilege Gold 386-40C, a PC motherboard based on the 40-MHz AM386 chip. The board features a 128K cache—expandable to 256K, eight 16-bit expansion slots, and a socket for a numeric coprocessor that supports both synchronous and asynchronous operations. The baby AT-sized motherboard also includes an on-board diagnostics LED.

List Price: Privilege Gold 386-40C, price not available. Orchid Technology, 45365 Northport Loop West, Fremont, CA 94538; 415-683-0300.

CIRCLE 442 ON READER SERVICE CARD

AT&T Develops a 5.7-Pound Notebook for Mobile Communications

NEW **AT&T**'s new Safari NSX/20 notebook has an integrated 2,400-bps modem with CCITT V.22bis, CCITT V.42 error correction, and MNP5 data compression. AT&T bundles the system with DOS 4.01, *Microsoft Windows* 3.0, AT&T *Mail*, and a graphical *Tour Guide* system tutorial. AT&T's version of *Windows* has been customized for laptop use with an extra large mouse pointer.

The 20-MHz 386SX notebook measures 1.8 by 12 by 9.5 inches and weighs 5.7 pounds. The weight goes up to 6.5 pounds with one high-energy nickel cadmium battery and 7.3 pounds with two. One battery lasts 2 to 3 hours, while a dual battery pack lasts up to 6 hours, according to the manufacturer.

AT&T offers a 40MB or an 80MB hard disk and system memory expandable from 2MB to 8MB. The Safari NSX/20 comes with a 3.5-inch 1.44MB floppy disk, a two-button mouse, and a full 82-key keyboard with 12 function keys. The 10-inch screen provides triple supertwist VGA, and electroluminescent backlighting.

The notebook contains a parallel port, an external VGA port, an external AT-bus port for expansion, a multifunction mouse, keyboard, or numeric keypad port, two RS-232C serial ports, and two RJ-11 modem connectors (telephone and line).

List Price: Safari NSX/20, with 40MB hard disk, $5,399; with 80MB hard disk, $6,399. AT&T, 1 Speedwell Ave., Morristown, NJ 07960; 800-247-1212.

CIRCLE 443 ON READER SERVICE CARD

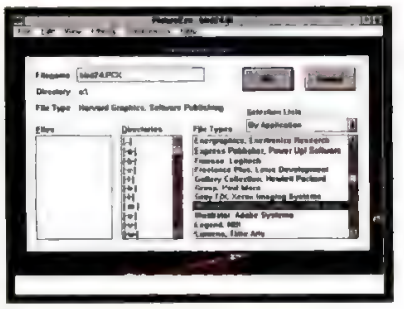
HOT PROSPECT

PICTUREEZE SELECTS THE WINDOWS GRAPHICS FORMAT THAT WILL WORK BEST

In an effort to eliminate the guesswork in choosing graphics formats, **Application Techniques** has introduced *PictureEze*, a file-conversion program for *Windows* 3.0 that selects the best format based on the application to which you are importing the image.

For $149, *PictureEze* supports a large variety of file formats, including .BMP, .DIB, .MSP, .GIF, .CUT, .EPS, .IMG, .PCX, .PIC, .PZI, .VMG, .TGA, .WIN, .TIF, and .WPG. Whatever type of image bitmap file you have, *PictureEze* will change it to the format needed for your particular application. The package can also convert to a supported application such as *PageMaker* or *WordPerfect* instead of a specific file format.

As part of the post-conversion process, the program offers many ways to manipulate images. You can crop or resize; flip, rotate, or mirror the image; and adjust brightness, colors, and contrast.



With *PictureEze* you can convert your image to the file formats best suited to import into your app.

List Price: *PictureEze*, $149. **Requires:** 2MB of hard disk space, *Windows* 3.0. Application Techniques Inc., 10 Lomar Park Dr., Pepperell, MA 01463; 800-433-5201, 508-433-5201.

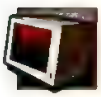
CIRCLE 440 ON READER SERVICE CARD

BRIEFS

GRAPHICS BOARDS

Monolithic Systems has announced the MicroVGA 452 video controller. The $395 half-length card provides "Ultra VGA" resolutions of 1,538 by 1,280 by 742,813 colors. It comes with 512K of RAM, anti-aliasing capabilities, and drivers for *Autodesk* applications. 303-790-7400.

Video Dynamics' FlashVGA video display adapter combines a high-speed, hardware-configurable graphics accelerator with Super VGA resolutions of 1,024 by 768 pixels with 256 colors from a 256,000-color palette. The $695 board uses the Tseng Laboratories ET4000 video controller. 415-863-3023.



MONITORS

Amax Engineering has added the 14-inch Impression Plus monitor to its product line. The $450 monitor supports noninterlaced resolutions up to 1,024 by 768 with a 0.28-mm. dot pitch. 415-651-8886.

Everex is shipping the EverVision SVGA, a 14-inch multifrequency color monitor with VESA support in 640 by 480 (72 MHz) and 800 by 600 (60 MHz) video modes. The $699 monitor is compatible with a broad range of graphics standards. 415-498-1111.

Optiquest has designed a 14-inch, noninterlaced, multiscanning color monitor that supports 1,024 by 768 resolution. The $695 Optiquest 1000 features a 0.28-mm. dot pitch and an unlimited palette of colors. 800-THE-OPTI, 213-948-1185.

TVM Professional Monitor Corp. has introduced the SuperSync 5A, an $895 15-inch, flat-screen color monitor that supports multiscanning with up to 1,024 by 768 noninterlaced resolution. TVM's monitor features a 0.28-mm. dot pitch. 714-985-4788.

ViewSonic's new 14-inch, ultra VGA color monitor, the ViewSonic 6, provides a 0.28-mm. dot pitch, a high-contrast, nonglare etched screen, and multiscanning support up to 1,024 by 768 (noninterlaced) resolution for $699. It offers VESA support at the 800 by 600 pixel mode. 714-545-5371.

$520 Adapter Marries 8514/A, TIGA Graphics

NEW An intelligent graphics adapter from **Unitron**—PcPalette—offers compatibility with the 8514/A interface and TIGA standards. When connected to a VGA card, the display reaches up to 1,024 by 768 pixels (interlaced and noninterlaced).

The $520 board's dual processing environment increases the speed of applications because they are partitioned between the CPU and the PcPalette processor—TI's TMS34010.

The graphics adapter contains 1MB of video RAM for image processing and 512K of DRAM (expandable to 1MB) for program space. It is compatible with software such as *Windows*, *AutoCAD*, and *VersaCAD*, and operates in VGA mode, as well as advanced mode, so software compatibility is greater.

List Price: PcPalette, $520. **Requires:** 640K RAM, VGA adapter, DOS 3.3 or later. Unitron Computer USA Inc., 736 Stimson Ave., City of Industry, CA 91745; 818-333-0280.

CIRCLE 444 ON READER SERVICE CARD

ImageCELs CD-ROM Contains 1,150 Images

NEW Designed to aid the development of photorealistic two- and three-dimensional computer graphics, **ImageTects**' *ImageCELs* CD-ROM contains 1,150 images and texture maps for use in a variety of applications including CAD, video animation, presentation graphics, paint, and even desktop publishing.

The $395 CD-ROM library provides a multiplatform solution for Amiga, DOS, Macintosh, and Unix users. Each of the images comes in 14 different file formats, including .TGA, .TIF, .PICT2, .CEL, .IFF, .GIF, .I16, and .DIB.

Files on the *ImageCELs* CD-ROM disk are available in 14 formats, including .TIF, .GIF, and .TGA.

List Price: *ImageCELs* CD-ROM, $395. ImageTects, 7200 Bollinger Rd., #802, San Jose, CA 95129; 408-252-5487.

CIRCLE 445 ON READER SERVICE CARD

Genus Launches $199 Graphics Library

NEW Attempting to replace graphics libraries such as Borland's *BGI* and *Microsoft Graphics*, **Genus Microprogramming** has added *GX Graphics* to its *GX* development series. The $199 package is a complete graphics library that supports all standard graphics primitives from pixels to ellipses.

The Genus library also provides advanced options, such as SVGA support, viewport definitions, fast ROM text displays, mouse programming routines, and the ability to draw to off-screen buffers in conventional, expanded, or disk memory in over 100 routines.

The *GX* kernel gives you powerful imaging functions like Put/GetImage, palette manipulation, scaling, and virtual display. Common functions are linked directly into the developer's application, and the kernel is responsible for all display adapter interfacing, memory allocation, and virtual bitmap support—all at assembly language speed. According to the manufacturer, *GX Graphics* supports all major compilers, languages, and video modes.

List Price: *GX Graphics*, $199. **Requires:** 256K RAM, DOS 3.0 or later. Genus Microprogramming, 11315 Meadow Lake, Houston, TX 77077; 800-227-0918, 713-870-0737.

CIRCLE 446 ON READER SERVICE CARD

$895 Color Scanner Includes Software for Graphics Editing

NEW **Migraph**'s $895 CS-4096 color hand scanner bundle comes complete with software for scanning, editing, and image processing in the *Windows* 3.0 environment. The package includes the CS-4096 color hand scanner, Migraph's color scanning utility, Astral Development Corp.'s *Picture Publisher Plus*, and Computer Presentations' *ImagePrep*.

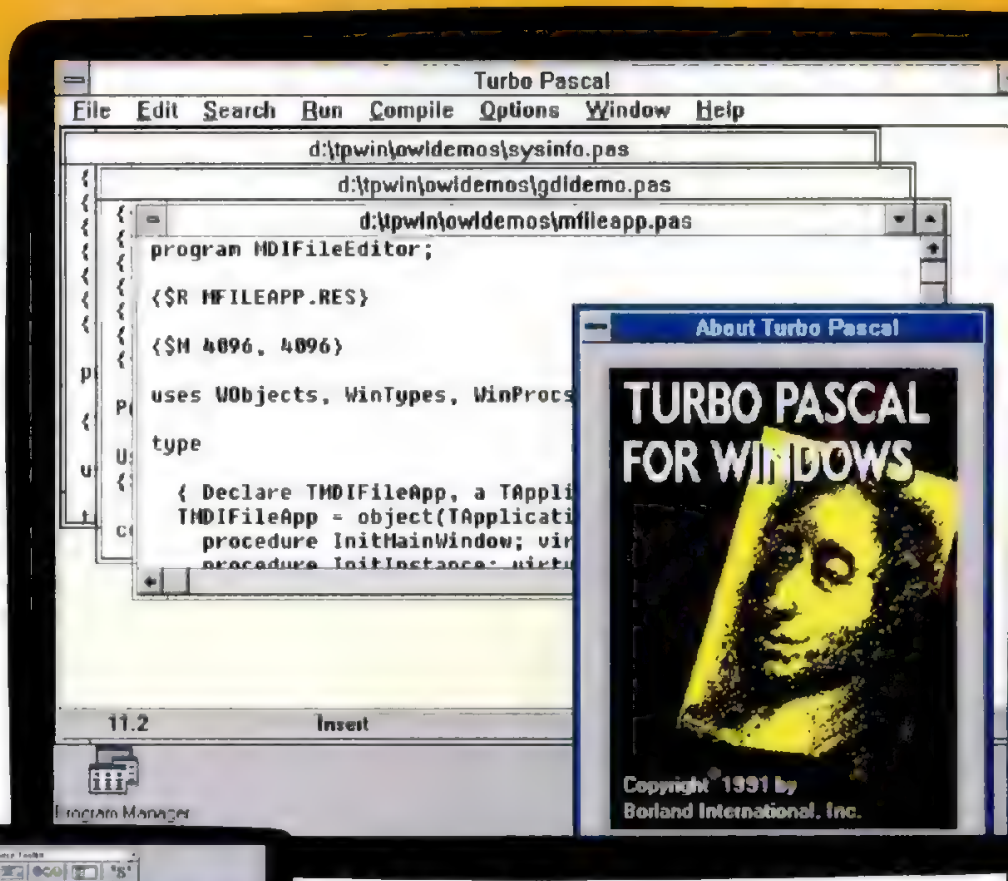
Migraph's single-pass color scanner has a half-page scanning window. It offers three scanning modes—color, dithered halftones, and line art—plus 256 levels of gray scale via post-scanning software conversion.

The software saves images in .PCX file formats ranging from black and white to 4,096 colors. *Picture Publisher Plus* 2.5, a 24-bit image editing package, works on VGA and SVGA systems. *ImagePrep* 3.1, is capable of 256-level gray-scale conversion of color scans and file compression up to 20:1.

List Price: Migraph's CS-4096 color hand scanner bundle, $895. **Requires:** 2MB extended or expanded memory, VGA, 16-bit slot, and *Windows* 3.0. Migraph Inc., 200 S. 333 St., #220, Federal Way, WA 98003; 800-223-3729, 206-838-4677.

CIRCLE 447 ON READER SERVICE CARD

New Turbo Pascal for Windows Don't Leave DOS Without It!



Go with Borland, the leader in OOP and Windows programming, when you're heading for the Windows frontier. With Turbo Pascal® for Windows, your Windows applications will be faster and easier to create.

Turbo Pascal for Windows includes Borland's new ObjectWindows™ application framework FREE. So now you can develop Windows applications fast because they automatically inherit code for windows, menus, dialogs, controls, and more.

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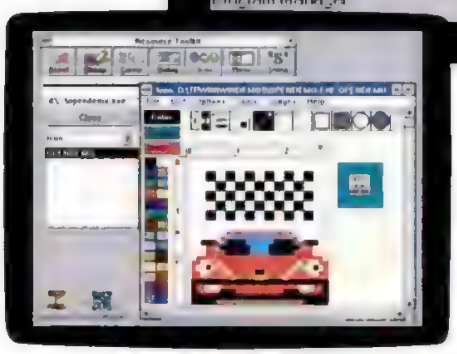
Turbo Pascal for Windows gives you more *and* costs you less than other Windows development systems. It's designed exclusively for Windows programming, and everything you need is included in the one low price. You don't need to buy the Microsoft® Windows Software Development Kit (SDK).

Turbo Pascal for Windows is the easiest way to make your next program a Windows program.



▲ **Create Windows Applications in Windows.** *The Windows Integrated Development Environment (IDE) lets you create, edit, compile and run your programs, all from within Windows.*

◀ **Create Windows Resources Visually.** *Using the Resource Toolkit, you can visually create your Windows user interfaces without programming.*

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CIRCLE 295 ON READER SERVICE CARD

BRIEFS

MODEMS

Adtech Micro Systems added the 11.5-ounce Eternally Yours! fax and modem to its PerfectFax family. The $345 2,400/9,600-bps modem features MNP5 error detection and correction. A non-MNP5 version sells for $295. The portable unit lets users schedule fax times and merge fax files. 415-659-0756.

Computer Peripherals has released the ViVa 9642e, a 9,600-bps modem with V.42bis data compression, error detection, and correction. The $695 unit has a maximum throughput rate of 38,400 bps and supports both leased and dial-up lines. 800-854-7600, 805-499-5751.

Dallas Fax has introduced the 2496 Fax/Modem. The internal unit contains a 9,600-bps send/receive fax and a 2,400-bps, MNP5 data modem. The $195 unit features programmable background faxing. 214-335-4329.

Ven-Tel is shipping the Pocket Modem with Fax 24/96S. Designed according to CCITT V.22bis specifications, the $189 pocket-sized unit supports full duplex asynchronous communication at 2,400 bps, 1,200 bps, and 300 bps. The fax meets the Group III standard at 9,600 bps. Ven-Tel bundles the unit with *Quick Link II Fax* software. 800-538-5121, 408-436-7400.

1-2-3 ADD-INS

Intex Solutions has released a fixed-income data retrieval program that provides spreadsheet users with a permanent link to financial data. For $95, *FIDO* imports financial information into your *Lotus 1-2-3, Symphony, Quattro Pro,* or *Microsoft Excel* spreadsheet. 617-449-6222.

Pizanno and Co. has introduced two new add-ins for *Lotus 1-2-3* that utilize the 3-D technology of Release 3.1. *Geneva Financial Forecasting* uses quantitative forecasting techniques and financial rules to create financial plans. *Geneva Financial Consolidation* includes automatic currency translations, consolidation rules, and reporting capabilities. 617-935-7122.

$79 Windows Utility Schedules Events for Background Operation

NEW You can now arrange for unattended operation of both *Windows* and standard DOS programs with **Aldia Systems**' event processing program—*Time After Time*. This $79.95 *Windows* application lets you schedule predetermined times and dates to have programs run automatically.

Especially useful for programs that need to run routinely, *Time After Time* automates activities such as: backing up workstation data to a network server, uploading or downloading information between remote locations, or performing compute-sensitive tasks such as statistical analysis or database manipulation.

Unlike DOS programs that require a TSR, *Time After Time* manages complex program schedules in a *Windows* multitasking environment. This capability lets you schedule applications as necessary. The scheduled program runs in the background. Users can also schedule one-time events through the *Windows* 3.0 calendar program.

List Price: *Time After Time*, $79.95. **Requires:** *Windows* 3.0, DOS 3.3 or later. Aldia Systems Inc., P.O. Box 37634, Phoenix, AZ 85069; 602-866-1786.

CIRCLE 448 ON READER SERVICE CARD

deskMinder Enhances Windows 3.0 Program Manager Tasks—$199

NEW A *ToolBook* application designed to make the *Windows* graphical user interface even easier, *deskMinder*, **TechSoft**'s front end for *Windows* 3.0, lets you incorporate and launch both *Windows* and non-*Windows* applications. Desk drawers are the metaphor used to represent file organization. You simply open the drawers and place data and document files into folders. You can move files between open folders, as well as drag folders between open drawers.

Using a true desktop metaphor, *deskMinder* presents a simple way to organize your files.

The program is fully customizable, letting users create custom icons for their specific applications. It offers links to e-mail and file server, mini or mainframe PCs.

In addition, *deskMinder* still lets you access *Windows*' Calculator, Clock, Calendar, Cardfile, Clipboard, Notepad, File Manager, and Program Manager.

List Price: *deskMinder*, $199. **Requires:** 2MB RAM, 1.5MB free hard disk space, *Windows* 3.0, DOS 3.1 or later. TechSoft Systems Inc., 1375 Kemper Meadow Dr., #11, Cincinnati, OH 45240-1650; 800-825-8386, 513-825-8386.

CIRCLE 449 ON READER SERVICE CARD

Contact Software Links With DBMSs, Prints Envelopes, Auto-Dials

NEW **PC Answers International** has released a $95 contact software package, *UCAN*, which allows users to browse through a database using any of the following tags: names, addresses, companies, departments, phones, voice/fax/extensions, dates, and memos.

Claiming to support all printers, *UCAN* does mass printing of letters or labels, and automatically inserts cities and states according to the given ZIP code. PC Answers packages its software with letter libraries for standard businesses, insurance agents, and real estate agents. In addition, *UCAN* includes automatic telephone dialing, on-line help, and basic word processing capabilities.

List Price: *UCAN*, $95. **Requires:** 512K RAM, DOS 2.0 or later. PC Answers International Inc., 1207 Grayland St., Greensboro, NC 27408; 919-274-7773.

CIRCLE 450 ON READER SERVICE CARD

DiskDupe Pro Formats And Copies Floppies

NEW **Micro System Designs** has introduced *DiskDupe Pro* for copying floppy disks. Via a pull-down menu interface, the $179 program formats disks, performs byte-by-byte comparisons, stores master disk image files, and copies directly from a 5.25-inch to a 3.5-inch floppy disk.

DiskDupe Pro completely reads the master disk into memory and onto the hard disk . It then makes as many copies as needed without having to reread the master disk. According to Micro System Designs, *DiskDupe Pro* duplicates 62 5.25-inch disks per hour—200 per hour if the disks are already formatted. ■

List Price: *DiskDupe Pro*, $179. **Requires:** 256K RAM, DOS 2.0 or later. Micro System Designs Inc., 4962 El Camino, #204, Los Altos, CA 94022; 415-964-2844.

CIRCLE 700 ON READER SERVICE CARD

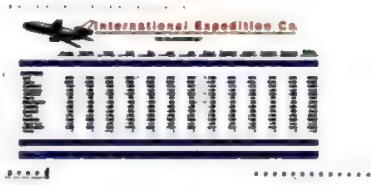
With Quattro Pro's WYSIWYG, what you see onscreen is what you get on paper.

Borland's New Quattro Pro 3.0 WYSIWYG and WYSIwow!

Quattro® Pro is the hottest spreadsheet on the market. Consistently delivering the best power features: Multiple worksheet consolidation, advanced publishing and 1-2-3® compatibility.

Now Quattro® Pro 3.0 adds WYSIWYG, plus a theatre full of graphics, publishing and presentation features that will dazzle even the most demanding audience. And, unlike 1-2-3 r3.1, all of Quattro Pro's features, including WYSIWYG, are seamlessly integrated into one set of menus, greatly enhancing ease-of-use. Just another example of how Quattro Pro's advanced technology is built in . . . not tacked on.

Choose from a spectacular library of fonts, colors, graphics and clip art to create winning presentations. There's even slide-show sound and transition effects!



New Banner and Print-To-Fit printing options let you print reports your way.

Quattro Pro 3.0 beats 1-2-3. Again.

Feature	Quattro Pro	1-2-3 r3.1	1-2-3 r2.2
"Live" editable WYSIWYG spreadsheet	Yes	Yes	No
WYSIWYG page preview	Yes	No	No
Banner (sideways-oriented) printing	Yes	No	No
Print-To-Fit™ automatically on a page	Yes	Yes	No
Backsolver technology built in	Yes	No	No
3-D graphs (ribbon, step, bar, area, pie)	Yes	No	No
Worksheet zoom	Yes	Yes	No
Draw package built in	Yes	Yes	No
Clip art library	Yes	No	No

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*ProView includes 100 additional CGM clip art images, 20 professionally designed chart styles, a full color "how to" presentation guide, additional fonts and sounds, plus $100 worth of 35mm slide service processing from Brilliant Image.® Upgrade pricing in U.S. dollars and good in U.S. and Canada only. Dealer prices may vary. Copyright ©1991 Borland. BI 1401A

CIRCLE 287 ON READER SERVICE CARD

Improved

BRIEFS

CONNECTIVITY

Network General has announced the availability of the *Distributed Network Sniffer* (from $4,995 to $10,995), a LAN and WAN diagnostic tool for geographically dispersed Ethernet and Token-Ring networks. It provides seven-layer analysis and communicates with SNMP-based managers. 415-688-2700.

Triton Technologies has released Version 5.0 of *CO/Session* ($125), its remote LAN access program. This release offers remote mouse operation, access to expanded memory, and compatibility with *DESQview*. 201-855-9440.

LANSystems is offering *LANSpool Si* ($395), a special version of its print-server, *LANSpool*, optimized for the graphics capabilities of Hewlett-Packard's HP LaserJet IIISi. 800-458-5267, 212-995-7700.

US Sage is now bundling Multisoft's *Super PC-Kwik* disk-caching software with its economical Ethernet LAN, *MainLan* (starter pack: $525 for 64 nodes. *Super PC-Kwik* upgrade price: $49). The company claims that the addition of disk-caching eliminates speed problems found in *PC Magazine* tests (First Looks, March 12, 1991). 800-999-6770, 407-331-4400.

ACCOUNTING

Great Plains has upgraded its *Great Plains Accounting Series* ($295 for kernel, modules $795) to include enhanced report generation, unlimited budgeting and history, and automatic transaction allocation in the general ledger module. Version 6.0 also adds a graphics reporting module with a macro keystroke recorder, enhanced printing, and customizable menus. 701-281-0550.

Macola now offers Version 5.0 of *Macola Accounting Software* ($195 for kernal, modules $795 and $895). The new release adds a graphical interface, keyboard macros, graphing, and password protection. New components include: invoice processing, a notepad, an inventory item history report, and serial/lot number tracing. 800-468-0834, 614-382-5999.

Applause II Adds Screen Shows

IMPROVED **Ashton Tate**'s presentation graphics package, *Applause II*, now features a screen show builder and runtime compiler to create standalone disk-based presentations. Also added to Version 1.5 are an 80,000-word spell-checking dictionary, full LAN support, encapsulated PostScript (EPS) file support, and 11 new transitional effects including tiles, melts, and drop plates.

A new multitasking feature allows toggling up to 12 different DOS applications within *Applause II*. *Applause II* supports LIM 4.0 memory management to access expanded memory.

Ashton-Tate's *Applause* uses a spreadsheet metaphor to build desktop slide shows.

List Price: *Applause II*, Version 1.5, $495; upgrades from Version 1.0, $50; upgrades from *Draw Applause* and *Master Graphics*, $75; network access pack, $395; network five-pack, $995. **Requires:** 512K RAM, DOS 3.1 or later. Ashton-Tate, 20101 Hamilton Ave., Torrance, CA 90509; 213-329-8000.

CIRCLE 436 ON READER SERVICE CARD

Phar Lap DOS Extender Uses XMS

IMPROVED **Phar Lap Software** has released Version 3.0 of its *386/DOS Extender Software Development Kit (SDK)*. The package includes the Phar Lap assembler, linker, DOS Extender *(Run 386)*, and protected mode debugger. PharLap's *Virtual Memory Manager (VMM)* is available as an option. The product is now XMS-compatible, has a smaller conventional memory footprint, and with the *VMM* option, allows data files to be mapped directly to memory without file calls or pointers.

Phar Lap says applications built with Version 3.0 will be compatible with the forthcoming MS-DOS 5.0 as well as with *Windows* in Real and Standard modes; compatibility with *Windows/386* Enhanced mode will be added in a later release, according to Phar Lap.
List Price: *Phar Lap 386/DOS Extender SDK* Version 3.0, $495; upgrades, $150. *Virtual Memory Manager*, $295; upgrade, $25. **Requires:** 80386-based PC, 512K, DOS 3.0 or later. Phar Lap Software Inc., 60 Aberdeen Ave., Cambridge, MA 02138; 617-661-1510.

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MacLinkPlus 5.0 Adds 50 New File Formats

IMPROVED **DataViz** has added 50 file translation paths to its DOS/Macintosh platform-linking packages, *MacLinkPlus/Translators* and *MacLinkPlus/PC*. Version 5.0 adds support for *Windows* applications including *Word for Windows* and *Windows'* .BMP files. The new version also supports *MultiMate* 4.0 as well as allowing PCs access to data files for the Macintosh applications *WordPerfect* 2.0 and *FrameMaker*.

MacLinkPlus has also added DOS Mounter, which provides direct access to DOS disks used in the Macintosh's FDHD Superdrive. The combination of new file filters and the DOS Mounter promises the transparent transfer of word processing, database, spreadsheet, and graphics files for offices using both PCs and Macs. *MacLinkPlus/PC* comes with additional serial cables for direct file transfers to Macintoshes without Superdrives.
List Price: *MacLinkPlus/PC*, Version 5.0, $199; *MacLinkPlus/Translators*, $169; upgrades $50. **Requires:** PC with 512K RAM, Macintosh, DOS 2.1 or later. DataViz Inc., 55 Corporate Dr., Trumbull, CT 06611; 203-268-0030.

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Microsoft's MASM Automates Tasks

IMPROVED **Microsoft** has added programming productivity features that provide task automation, intuitive data jumps and pointers, as well as a conversion utility for C header files to its assembly language programming kit, Macro Assembler 6.0. The integrated development environment includes a source browser, an enhanced CodeView debugger, an editor, and an on-line reference.

Version 6.0 has replaced the two-pass assembler found in earlier versions with n-pass, enabling faster assembly and eliminating phase errors and assembler-generated NOP statements. The system supports the 80486 instruction set and FLAT memory for optimized 32-bit programming. A conversion utility ensures compatibility with Versions 5.*x*. ■
List Price: Microsoft Macro Assembler, Version 6.0, $150; upgrade $75. **Requires:** 640K RAM, DOS 3.0 or later. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080.

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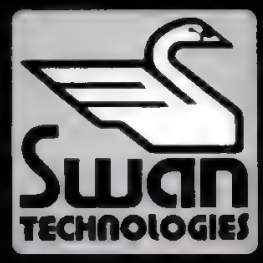

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edited by
Matthew J. Ross

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Reviews of the Latest Books for the PC User

Adobe Redefines PostScript with a New Edition of Its Red Book Edition

The *PostScript Language Reference Manual* is the first major revision to the original "red book" from Adobe Systems, and if you are now a PostScript programmer, or are thinking of becoming one, this book is exactly what you need.

The most important new feature to the red book is the inclusion of every update and extension to PostScript. At the top of the list is Level 2, the most recent changes to the PostScript language. Level 2 came about through the evolution of the language as it relates to new technologies. PostScript could not have anticipated changes in the marketplace or the plethora of graphic arts product introductions. To keep pace, Adobe extended the original PostScript language. These extensions cover areas such as color print devices utilizing the CMYK (cyan, magenta, yellow, black) process color model. Extension operators that were included in separate "white papers," such as setcmykcolor, now are included in the operator definitions within Level 2.

Display PostScript, the language extension that addresses computer displays, is also covered within the new red book. Currently only a small number of devices support this branch of the language. Included in the supported product list is the NeXT computer. Programmers that wish to have true WYSIWYG, look no further. The language instructions to the display interpreter are transportable to the printer's interpreter. There is obviously no better one-to-one relationship.

Overall, Adobe's book is well organized. It contains an alphabetical listing of the language operators and error messages, as would be expected. New additions include a few graphical icons that help identify those operators that are exclusive to Level 2 PostScript interpreters, or to Display PostScript.

As the market continues to move toward color, PostScript also expands to meet the needs of developers addressing this area. The CIE color space model has been included in this level of PostScript. The book contains a good number of theoretical and programming examples to help the reader understand the 1937 color model.

With color coming on strong in the nineties and color scanning being a part of that movement, PostScript needed a few new ways to handle huge files. Level 2 has added some compression standards that are chip-level compatible. The *PostScript Language Reference Manual* reviews these compression types and the language hooks to them.

The Encapsulated PostScript (EPS) file format, now in Version 3.0, is outlined as well. Examples are offered that illustrate the creation of an EPS file with an attached TIFF image. Finally, if you were hoping to get the inside information on Adobe's previously proprietary type 1 font specifications, it's not here. The documents for that font-handling information are available from Adobe directly.

Since both the original and this newer version of the red book are written, tested, and authorized by Adobe, you cannot pass this one up as the authoritative source for information. The red book's foreward is written by John Warnock and Charles Getsche, the two founders of the PostScript page description language. With all this credibility, the *PostScript Language Reference Manual* is the end-all reference to the PostScript language.—*Gerard Kunkel*

PostScript Language Reference Manual, Second Edition

by Adobe Systems Inc., $28.95. Addison-Wesley, Reading, MA 01867; 617-944-3700. ISBN: 0-201-18127-4

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"Master C" Tutorial Offers Solid Fundamentals for C Programming

The Waite Group's Master C is a book-and-disk set that purports to be "revolutionary" and "to turn your PC into a sophisticated C instructor." It is remarkable instead for how well its lessons adhere to sound, traditional programming concepts, and how well its implementation enforces them. The book itself is almost an aside to the Master C software tutorial. Most of the book is a brief reference to the C language. The rest introduces the on-disk program, and helps you install it and get started.

The Master C program allows you to follow a 15-chapter tutorial that the authors claim will take 31 hours to complete. You can also go directly to a question you might have about a language concept by querying the program's glossary for definitions and relevant lessons.

In the tutorial you are presented with important programming concepts, then tested on them. You are asked a question, and you must type the answer. This consistent reinforcement is a sound teaching approach. It seems that what is referred to as "revolutionary" is a rudimentary parser that allows you to answer questions in free-form text, even, or so the book proclaims, to misspell your answers. The parser somehow (magically) knows if you are correct. It is supposed to know enough from your answers to suggest you take a remedial lesson (if your answer is way off base) or to show you pick lists (if your answer is close but inexact).

We found that the parser was unable to decipher spelling, however. It did not recognize "wriet" as "write," nor "STDIO.H" when it was spelled "STIDO.H." Typing "outpu" got the reply, "Right so far," which was helpful but a bit ambiguous. Its suggestions to retreat were about as accurate as its spell-checker, and there is no way to correct misspellings, except to retype the entire answer.

Even if you don't care for the gimmicky interface, there is much to recommend *Master C*. The lessons are wonderful tutorials on programming and the C language. Whether you are new to the language, to programming, or just in need of a refresher course, you'll find Master C of value. Since the substance of the lessons comes from the Waite Group's *New C Primer Plus*, you may choose substance over form entirely, if you wish.
—*Rick and Sue Ayre*

The Waite Group's Master C: Let the PC Teach You C

by Mitchell Waite, Stephen Prata and Rex Woollard, $44.95. Waite Group Press, Mill Valley, CA 94941; 415-331-0575. ISBN: 1-878739-00-x

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A Programmer's Look Inside Super VGA Architecture

Advanced Programmer's Guide to Super VGAs: The Advanced Programmer's Graphic Library Volume II is the follow-up by George Sutty and Steve Blair to their original advanced guide on EGA and VGA. In this case, Volume II quickly moves from the basics right into Super VGA, the book's focus.

Since the fundamental architecture of Super VGA is identical to IBM's VGA, Sutty and Blair concentrate on how to take advantage of the higher color and resolution that Super VGA has to offer. This requires a greater amount of display memory than is found in the standard IBM VGA. Accessing this larger display memory area requires some type of memory paging mechanism (similar to the way EMS memory works). Since each Super VGA chip set manufacturer implements this paging mechanism differently, Sutty and Blair explain memory paging in detail, getting into the specifics of each chip set's memory paging scheme.

At 598 pages, the topic is well organized, skimming the fundamentals of VGA with chapters on VGA display modes, VGA architecture, registers, and ROM BIOS, and then moving quickly into Super VGA architecture. Sutty and Blair cover all the major vendor's chip sets including: Ahead Systems, ATI Technologies, Cirrus Logic, Chips and Technologies, Genoa Systems Corp., Headland Technology (Video Seven), Trident, Tseng Laboratories, Western Digital/Paradise, and ZyMOS.

In addition, Sutty and Blair provide a 1.2MB disk full of 4-, 16-, and 256-color memory and drawing routines that are easy to follow. The authors customize these examples for each chip set to perform the outlined functions. The software is written entirely in macro assembler (MASM), hence it is usable with most high-level languages with little or no modification. The code is the ultimate strength of this guide.

In the *Advanced Programmer's Guide*, Sutty and Blair concentrate their efforts on Super VGAs. They assume that if you really want to know about EGA and basic VGA, you'll get their first book on the subject. They do a thorough (if somewhat brief) job on VESA, and the VESA BIOS from a programming standpoint; most of the coverage here is in the form of code, not in textual descriptions. Appendices summarize the regular VGA video BIOS, VGA registers, and standard VGA modes, and the authors also provide a glossary of terms and a directory of video manufacturers.

If you need a book that deals specifically with Super VGA, Sutty and Blair do a fine job of covering the topic in detail, particularly its code examples. These alone make the $44.95 cost of the book an excellent value.
—*Robert W. Kane* ■

Advanced Programmer's Guide to Super VGAs
by George Sutty and Steve Blair, $44.95. A Brady Book, Simon & Schuster, New York, NY 10023; 800-624-0023, 212-373-8093.
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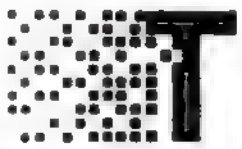

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CIRCLE 514 ON READER SERVICE CARD

edited by
Trudy Neuhaus

Toolkits

Reviews of the Latest Tools for the PC Programmer

Zortech's DOS 386 C++: A Speedy and Powerful Compiler

Zortech's new DOS 386 C++ Developer's Edition is DOS's first 32-bit native-code C and C++ compiler. It is based on Zortech's successful 16-bit DOS C and C++ compiler, which was the first native-code C++ compiler on the PC. DOS 386 C++ is available only in a pricey $995 Developer's Edition, which includes the compiler, a 32-bit symbolic debugger, the Zortech Workbench programming environment, miscellaneous utilities, C++ class libraries, Zortech Flash Graphics library, and source code to the class libraries and the C library. The 32-bit applications that it produces will operate only on 386 and 486 systems, though the compiler itself will operate on any DOS system. You will also need the $495 Phar Lap 386|DOS Extender SDK. If you want to distribute your 32-bit applications, you'll need Phar Lap's BIND386 utility as well.

Like the other established 32-bit C compiler vendors such as MetaWare and Watcom, Zortech claims that DOS 386 C++ is compatible with most C code written for 16-bit DOS C compilers. However, whereas the other 32-bit C compilers are traditional command line compilers, DOS 386 C++ is a complete software development environment.

DOS 386 C++ installs easily and consumes about 6MB of disk space. You can place Zortech's 32-bit compiler in the same directory as its 16-bit compiler and choose between 32- and 16-bit code generation using command line options. This makes it easy to produce simultaneous builds of your application in both forms. Unfortunately, this important capability isn't well documented.

In fact, Zortech's documentation is the weakest part of the package, imperfectly adapted from the 16-bit product. It contains too little 32-bit-specific information and too many 16-bit citations that are no longer correct. An example of the former is the lack of information on the 32-bit compiler's far-pointer type, which is a 48-bit pointer used on the 386 during protected-mode operation to address segments other than the current one. An example of the latter is the description of the MK_FP routine, which shows a 16-bit pointer manipulation that is incorrect for the 32-bit compiler.

One of the Zortech compiler's strongest aspects is its global optimizer. Based on the battle-tested 16-bit optimizer, the 32-bit optimizer significantly improves the quality of the generated code. In one test, a task that took 32 seconds using unoptimized 386 code became a 25-second task when the optimizer was used.This same code, when compiled and optimized by the 16-bit compiler, took about 29 seconds. Most code speeds up significantly when converted to 32-bit.

You may be wondering how hard it is to convert traditional C or C++ code to the 32-bit Phar Lap environment. Source code that doesn't have PC hardware dependencies and that hasn't been contorted by DOS's 640K limitation is easy to convert. Unfortunately, such code is not the rule. Most DOS programs have subtle subterfuges for dealing with the limited memory space, and most have numerous hardware dependencies. Phar Lap has taken care of all of the traditional (and many not-so-traditional) DOS Interrupt 21h calls, and Zortech supplies libraries for character display, graphics, and the mouse.

But that leaves many BIOS calls, timer and keyboard handlers, network interfaces, hardware interrupts, and other items that you must manage yourself. Although the techniques are spelled out in the Phar Lap documentation, Zortech could be more helpful with standard operations. For instance, there are a dozen or so Phar Lap–specific service requests, but Zortech doesn't supply a C interface for them.

The Zortech Workbench is an alternative to the traditional command line control of the edit-compile-debug cycle. The Workbench is a multiwindow editor that lets you compile your code, examine the compiler messages, run your application, call forth the debugger, and so on. The built-in help system explains how to use the Workbench, but it does not cover the C or C++ language or the library routines. To get help with these, use Zortech's help TSR. The Workbench also contains a pair of source code browsers, so it is easy to find things.

Unlike the Borland development environment, in which the compiler and a simple debugger are built in, the Zortech Workbench is more like an editor extended to make accessing your other programming tools convenient. The advantage of the Zortech approach is that you're always using the full-power version of the compiler, Make facility, or debugger. The advantage of Borland's approach is that there is no delay switching from one task to another, and the overall look and feel is superior.

The Zortech symbolic debugger, which is easily accessible from the Workbench, has been specially engineered for the Phar Lap environment. It is a simple-to-use multiwindow debugger. The three standard window panels show the current program source code, the global variables, and the current local variables. Of course, other views are possible.

Zortech's DOS 386 C++ is a convenient entrée to the 32-bit milieu, especially if you're already using its 16-bit predecessor. There are too many mistakes in the documentation, and there are the usual rough spots that come with any new product. But, overall, it is a reliable 32-bit compiler, with a useful programming environment, a good debugger, and an impressive code optimizer.

—*Kaare Christian* ■

Zortech's DOS 386 C++ is a convenient entrée to the 32-bit milieu, especially if you're already using its 16-bit predecessor.

Zortech's DOS 386 C++ Developer's Edition Version 2.1

List Price: $995. **Requires:** 80286-based PC or higher, hard disk with 6MB free space, Phar Lap's 386|DOS Extender, Phar Lap's BIND386 utility to distribute applications. Zortech Inc., 4-C Gill St., Woburn, MA 01801; 617-937-0696.

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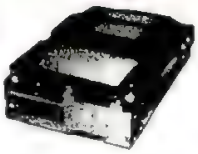

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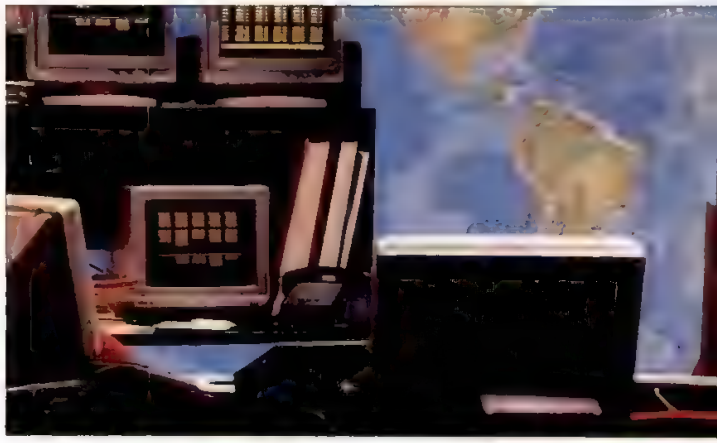

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Bill Machrone

The Race Is On!

You couldn't resist, could you? I wrote a little program, and now everyone wants to write it better. Forget it!

"Bill, I can write that program in ten lines." "Bill, I can write that program in three lines!" Readers have been playing the programmer's equivalent of "Name That Tune" ever since I mentioned here ("Back to BASICs," March 26, 1991) that I had written a quickie BASIC program to check my daughter's fourth-grade homework.

Programming one-upmanship is nothing new. When I got started in personal computing back in 1976, you usually had to write your own I/O routines—in assembler. Some of the programming challenges were quite real. When you only had 50 bytes to write a serial printer driver, you wrote it in 50 bytes, including the buffer. When you only had 2K for the entire BIOS, you learned to conserve every byte. Doing hex-to-ASCII conversion in 6 bytes (4 bytes was the best you could do, as I recall) was an absolute necessity.

Some of the letters that I received have been warm thanks for keeping the old BASIC flame alive. Others have been readers' improvements on my code—which they'd never seen. The topper so far has been an APL function (APL-ese for program) that claims to do everything my program did, in just three lines. This really piqued my interest. I've been fluent in several programming languages, and I am intrigued by the way the language affects your approach to the problem. I recall Edsgar Djikstra's legendary claim that teaching students BASIC should be a capital offense.

So here's your chance to show how you've escaped brain injury by never having learned BASIC, or how you've overcome the debilitating effects of GOSUBs.

You write a better program that does the same thing, in whatever language you choose. I'll pick some of the interesting ones, and we'll discuss them in a future column. I'm interested in technique as dictated by language capabilities, not just in brevity. For instance, APL invites you to think in arrays, but the submitted program doesn't cast out blanks and doesn't equate uppercase and lowercase letters. APL's method helps you analyze the problem, but it also uses Greek letters and special symbols for its operators, and reads right to left.

Below is a description of the original problem, and my program in all its embarrassing simplicity: A music store has decided to charge for sheet music by assigning a value to each letter in a song's title. You add up the value for each letter. Uppercase and lowercase letters have the same value. Spaces have no value. Leave punctuation out of the title. Just to make life interesting, the value for each letter is assigned from 1 to 26 cents, but not in alphabetical order. The values are in the DATA

```
10 DATA .02,.12,.16,.09,.10,.25,.03,.04,.17,.19,.06,.08,.05
20 DATA .11,.18,.20,.22,.13,.07,.01,.15,.14,.21,.26,.24,.23
30 LINE INPUT "Enter Song Title: ";TITLE$
40 FOR X=1 TO LEN(TITLE$)
50  LETTER = ASC(MID$(TITLE$,X,1))          'Get ASCII value
60   IF MID$(TITLE$,X,1) = " " THEN 150:    'Skip spaces
70   IF LETTER > 90
       THEN LETTER = LETTER-32               'Convert lower to upper
80  LETTER = LETTER-64                      'A=1, B=2, ...
90  RESTORE                                 'Start at beginning of DATA
100  FOR LOOP=1 TO LETTER                   'Index into data
110   READ LETTERVAL
120  NEXT LOOP
130  WORDVAL = WORDVAL+LETTERVAL            'Accumulate values
140 PRINT MID$(TITLE$,X,1), LETTERVAL
150 NEXT X
160 PRINT
170 PRINT "Total:", WORDVAL
```

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CIRCLE 727 ON READER SERVICE CARD

statements in my program in A to Z order.

Since writing this program, I've thought of two other ways to do it. Just writing this column, another one occurred to me. I've always been fascinated by this aspect of the human mind. Is it a ceaseless quest for perfection, or is it what the French call "staircase wit," the clever retort that occurs to you after you've left the big confrontation? Sometimes it's just easier to think when the pressure's off.

In this case, the pressure was on me to prove to my wife that writing the program was a more efficient way to check my daughter's homework than looking up all those letters and adding them together. Women are enormously practical in such matters, while resorting to techno-overkill is a typically masculine trait. So my pride was on the line, along with programming skills that I hadn't exercised in five years. Not that the above 17 lines were any great challenge, but I was pleased with myself for remembering the proper order of operators in the MID$ statement.

THE CONTEST

Of course, it's not really a contest. There's no winner-take-all, there's no time limit. We're definitely not looking for the fastest way to do it. Solving the problem in a minimum number of lines might be interesting as long as you don't resort to the idiocy of multiple instructions per line. Let's keep it readable. That way, I can look over your submissions and set aside the interesting ones, the ones that highlight the differences among languages and the ones that really lend themselves to the analysis and thinking process. I'll send a *PC Magazine* T-shirt to the authors of the ones I use. How's that for high stakes? I'm curious to see if I get any *Lotus 1-2-3* templates or *dBASE* programs. Is Pascal better than C for a quickie problem such as this? Is there a better BASIC solution? Perhaps we'll see a five-line APL function that does it all.

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Whither The Hobbyist?

The growth of the PC industry and lightning-fast technological changes have left computer hobbyists in the dust.

Nothing endures but change.
—Heraculitus, 402

When the microcomputer revolution began it was dominated by hobbyists—people who thought computers were nifty and fun to play with. They pushed the technology, and their prodding created trends and made things happen. Most of all, this group created the ethos of desktop computing by demanding individualism, encouraging individual programming, cheering low prices, and by just plain boosterism. There wouldn't be a *PC Magazine* or the mass-market computing scene if these people hadn't been actively promoting computing as a hobby back in the 1970s.

But what the hell happened to the hobbyists? Was it just a fad? Does computing cause people to burn out and get out?

Few pioneers are left who still regard computers as a hobby. Some went into the computer industry and became dull businessmen. Others simply dropped out. What ever happened to Don Tarbell, who was one of the first to sell the disk drive controller? Where's Bruce Seals? In the 1970s, he was one of the first sellers of add-in memory cards.

I first noticed the disappearance of the hobbyist when talk of "computer widows" disappeared from the general lexicon a few years back. There are no more computer widows, it seems.

Four things killed the computer hobby:

1) Business discovered the computer. Once the American businessman found out about the computer as an advantageous business tool, the vendors who were selling products aimed at hobbyists realized that they could make fortunes selling to the businessmen. They turned away from the hobbyist. The magazines that once appealed to the hobbyists followed suit (no pun intended).

2) The machines got too sophisticated. It's not much of a hobby to build a computer when everything is reduced onto one complex silicon chip that does it all. While there is more than one chip in a computer, it seems that VLSI is lowering the chip count like nothing imaginable. With surface mount technology, a guy can't even solder on a part anymore.

3) The rate of change was too rapid. Only an elite few can keep up with the yearly changes and concomitant expense of the hobby. It's not like collecting old cars or rare stamps. You can always take a breather with most hobbies. With computers the rate of change and the consequent expense of keeping up is too dear for all but a few users. So hobbyists get locked into older, still functional machines with no rationale to change.

4) Computers are not fun anymore—they're work. The joy of discovery is gone. Hobbyists used to get a kick out of programming in something weird like Tiny BASIC. They'd play with all the new public domain programs. Now if you program, it has to be in C++ or OOP Pascal and that requires laborious work to master. Worse, the deluge of shareware and public domain software make it hard to find anything fun. Being a computer hobbyist has become a full-time job.

There is still something compelling about those old computers, though, and I suspect that the hobby will return in a new form not unlike car collecting. Already we're seeing old machines resurrected. Recently I went to the United States Museum of American History in Washington, D.C., and was bug-eyed when I saw old computers on display.

ILLUSTRATION: STEVE DININNO

The computer hobbyists as we knew them in the 1970s are dead, for sure. But we should not forget their contribution. If they crop back up as collectors of old junk, be nice and give them that dust collector in the closet.

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John C.
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Inside Track

Where's There's Smoke There's Fire Dept.: Observers are wondering about the **implications** of IBM's conscious decision to roll into Japan. IBM is leading a straightforward attempt to **steal** the PC market there away from NEC, which controls 50 percent of the Japanese PC market. Along with Sony, Sharp, Sanyo, Ricoh, Oki, Panasonic (Matsushita), Mitsubishi, Fujitsu, Hitachi, and Toshiba, IBM will head a joint effort to **restandardize** the PC market in Japan. That means to get the Japanese away from the proprietary NEC standard that is incompatible with most of the world's computers. The NEC machine uses an idiosyncratic version of MS-DOS for its operating system.

This coup can be accomplished because the sales rate of PC-type computers in Japan is **a meager 2 million machines** a year. The standard machine—the NEC-9000 series—has an installed base of only 3 million. So the market is still immature enough for this plan to work.

But in the long term, what will IBM really get out of this maneuver, partnered with **free-swinging** home boy heavyweight competitors such as Mitsubishi, Fujitsu, and others all competing in the same **dubious fish** tank? Nobody can understand IBM's intent, figuring it will eventually **be creamed** in such a market.

Not necessarily. IBM hopes to set a fast pace and let the others follow. More importantly, the company is going out of its way to show that if it wants to be a leader, it can be a leader with little effort. At least when compared with Microsoft.

Yes, I said Microsoft. This entire scheme is nothing more than a power play between Microsoft and IBM. Hear this out.

The scheme evolved out of the **simmering feud** between IBM and Microsoft. This is the feud that everyone has denied but that smart observers keep assuring us is happening. The feud over the direction of the industry. The feud over Microsoft's emphasis of *Windows*. Even the fiasco over DOS 4.0.

You knew something was up when the **denials** flew fast and furious, and when pundits took sides. But where there is smoke there's fire. It finally erupted in a *Forbes* article where the two companies clearly stated that they were in **disagreement** about direction. Each company has its own vision of the future, and apparently IBM's James Cannavino and Microsoft's Bill Gates don't see eye to eye. In fact they may not even like each other. The **pettiness** of the feud came to a boil in *Forbes* when Gates, lacking humility, said that he and Microsoft were largely responsible for the success of the IBM PC and today's hot computer market. He made it clear that IBM's contribution to the leadership was a mirage—**bogus.**

> IBM's James Cannavino and Microsoft's Bill Gates don't see quite eye to eye. In fact, they may not even like each other.

A debate began, and some now talk about how IBM got lucky and how IBM's original PC was cassette-based and never taken seriously by the company. It was thanks to Microsoft that it became such a success. Furthermore, it can be argued that had Microsoft not marketed MS-DOS to Compaq and every **Joe Blow in Taiwan,** the market wouldn't have **exploded** at all. Besides that there is BASIC and C, *Excel* and *Word*, and all sorts of other important tools and applications to help push the technology—all coming from Microsoft. IBM came up with *EasyWriter*, *DisplayWrite*, a couple of repacked Microsoft languages and, uh, that's about it. Oh, yes. **AND** *TopView*.

So, back to Japan. IBM, **humiliated** by the situation, has decided to prove a point. The point is that Microsoft, as far as some IBMers are concerned, is no more a leader than a **West Texas clone maker.** Japan is the test. Microsoft has tried again and again to show leadership in Japan. First it was championing the **MSX standard.** This was going to be the be-all, end-all super standard for all home PCs. It flopped, as did its improved brother—MSX II. We'll count that as two flops in a row. NEC is holding firm. So here comes an assault that only IBM can put together. The goal is not to make money by selling PCs in Japan, but to put Microsoft in its place. To show Microsoft how it's done.

Either there's **something Biblical** about all this or it's just "boys will be boys."

Genuinely Interesting Hardware Dept.: To prove a point, a friend of mine who sells Panamax surge protectors showed me how at any trade show the power is **so erratic** that unprotected machines **blow up** all over the place. (And by protection he meant quality protection that you get from uninterruptible power supplies, or a good surge suppressor—Panamax and Zero Surge come to mind.) What he showed me was **the Probe 100**—a $129.95 line monitor that checks all three lines coming out of the socket to report power sags, failures, surges (by severity), hot lines, spikes, and open grounds. It also will report newly discovered **voltage threats** such as common-mode noise, high-frequency noise, and half-cycle dropouts. Essentially it's a box with a slew of LEDs that stay lit once a condition is experienced. **Plug this** into the electrical outlet at a show and it will make your **hair stand on end.** It's made by Eastern Time Designs; to order this **great product**, contact them at 2626 Brown Ave., Manchester, NH 03103; 603-645-6578. Ask for their catalog. It's a great way to **document faulty electrical systems** in places where people are blaming each other for service problems. ■

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Jim Seymour

Echoes From Mac-land

The market's invisible hand makes developments in the Macintosh market critical to all PC users.

There have been some interesting developments over in the Macintosh world lately. And some of them—but maybe not the ones you'd think—are going to affect powerfully those of us who work in the DOS universe.

The most visible event was the success of Apple's new, low-end Mac Classic in the Christmas selling season. Exact numbers are hard to come by, but the Classic was a smash hit. At $995 and $1,495 list for floppy-only and hard disk models, the Classic became the runaway success that has always eluded Apple.

So now pundits are saying Apple and the Mac have been resuscitated by the Classic. The Classic's boom will certainly help Apple's balance sheet for a couple of quarters... but Apple's long-term viability in the business-PC market is still in some doubt. With 60 million-plus DOS PCs out there now, versus maybe about 4 million Macs, that 15:1 market-size advantage for IBM compatibles commands attention, especially among software developers.

SOFTWARE DEVELOPMENT BLUES

Choosing which platforms to support is a hot issue for software developers. They've been whipsawed over the past few years among DOS, Macintosh, Xenix/Unix, OS/2 and OS/2 Presentation Manager opportunities. And, of course, there are sub-choices within those broad categories: for example, the *Windows* market under DOS, and the Unix market—which Unixoids keep saying is moving toward shrink-wrapped, off-the-shelf compatibility (read: one version of a program runs on all Unix machines) but never gets there.

It's a tough call. Development resources are *always* limited. No company I know believes it has enough programmers to develop for all the markets it would like to enter.

So it comes down to triage: trying to guess which platforms will grow and which will wither. Guess wrong and it hurts.

Ask Fred Gibbons, at Software Publishing Corp., for example. Last year, during the pre-*Windows* 3.0 publicity buildup, Fred spoke angrily about Microsoft's intentions. Microsoft had sold him and a lot of others a bill of goods, he said, by encouraging them to look beyond *Windows* and develop high-end business software for OS/2. But now it looked as if Microsoft was putting its bets on *Windows*. Which, of course, happened to be true.

Or ask Jim Manzi at Lotus. He spent a fortune developing *1-2-3/G* for OS/2 PM. It was released... and almost disappeared. No one was using OS/2 PM, so no one cared about apps for it.

In this triage, support for the Macintosh platform has been the easy cut. Why develop for a ghost?

Conventional wisdom still runs along those lines: You've gotta have DOS and *Windows* versions of your programs; Unix is a future play; Microsoft's "NT" (New Technology) operating system may be a good bet; old OS/2 PM is fading fast.

And the Mac? Forget it.

Even Mac developers have grown apprehensive. Stories of big-time Mac developers defecting to the DOS/*Windows* camp shake Cupertino every week. And, heresy of heresies, Claris, Apple's reabsorbed software subsidiary, has been advertising for *Windows* programmers.

ILLUSTRATION: STEVE DININNO

It's easy, in a theological war, to read the tea leaves backward, to get the facts right and the meanings wrong. That's happened in the Mac-PC software-development wars—a holy battle if ever there was one.

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on the Mac but has come to prominence and riches in the *Windows* world. Were they planning, I asked, to freeze their Mac product for awhile, while they focus on beefing up the *Windows* version?

No way, they responded, "We need the Mac product to help sell the *Windows* version." *Exactly!*

THE "OTHER" PLATFORM

Now that we are squarely in the Age of Interop, and moving toward catholic support of multiple platforms, software firms that want big and enduring hits are coming to understand that they have no choice other than to support the Mac—even if they don't expect to make money, directly, on that version.

Because corporate buyers are making it clear that if they're to adopt a program as a company-wide standard as they move to *Windows*, it must also support their users on other platforms. And the dominant "other" platform is the Mac. The number of "other" users may not be large, but it's politically unacceptable to leave them out in the cold.

Aldus and Microsoft understand that imperative very well. Ditto WordPerfect Corp. Lotus does, too. (Why do you think they resumed work on *1-2-3/Mac?* Certainly not because they see a big, rich Mac market waiting for them.)

Other developers are whistling past the graveyard, with brave words about ignoring the Mac "for now." But in private, they admit to worries that they may be hurting themselves.

So in this world of things seen and unseen, the really important news for Apple isn't that temporary explosion of cash from Classic sales, but the invisible hand: the attention being paid to interop by business.

What does this mean for you, as a PC user who doesn't give a hoot about the Mac? For one thing, you might tell the software publishers whose products you rely on that you want them to do Mac versions, too—lest they end up being swept under this powerful tide of interoperability.

For another, we need to watch what's going on in the larger world of desktop computers. Events and trends far afield are powerfully changing our comfortable DOS world. ■

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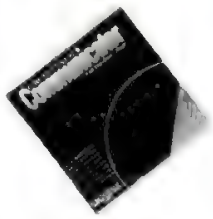

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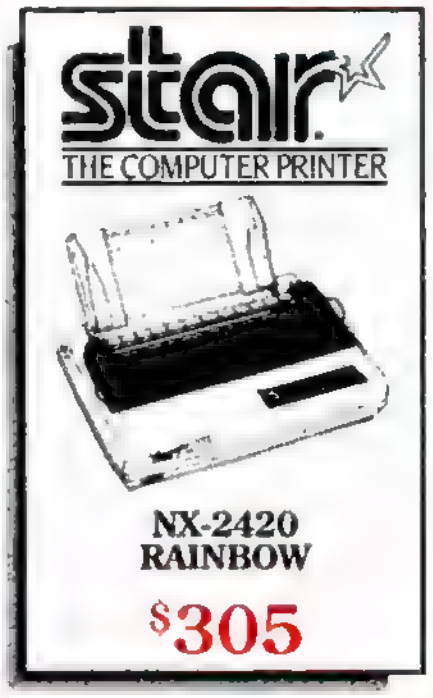

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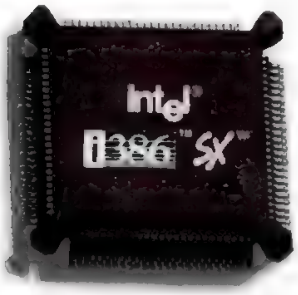

The PS/2® Laptop looks great from the outside. But its true beauty lies inside, where you'll find uncompromised computing power. It has the same 386SX™/20 MHz processor found in best-selling desktop models. A 3.5" 1.44MB disk drive and 2.5" 60MB fixed disk provide fast access to programs and data, and standard 2MB RAM is expandable to 18MB.

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Of course, it comes with an AC adapter, and a 2400 BPS Data Modem/9600 BPS Fax Modem is available, as well as a special mouse that doubles as a trackball when turned over. And the PS/2 Laptop comes with something no laptop should be without—an international warranty* backed by thousands of Authorized Remarketers worldwide, so service and support are never far away.

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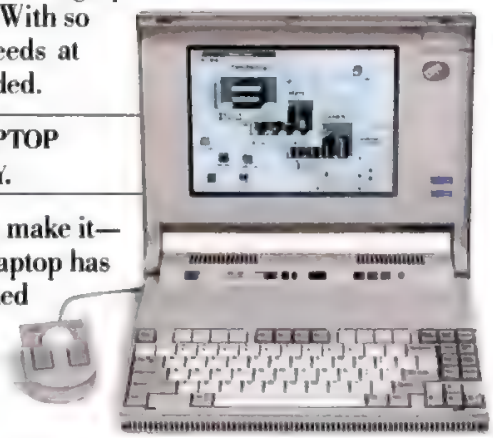

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CIRCLE 516 ON READER SERVICE CARD

William F. Zachmann

For Once, A Study Worth Studying

A survey of *PC Magazine* subscribers suggests that the future may not belong to *Windows*.

Computer industry market research is a lot like sausage—once you've seen it made, you are considerably less inclined to eat it. Lurking behind the portentous pronouncement "Our research shows..." is often little more than the scientific equivalent of "Start by sacrificing a chicken at the crossroads in the dark of the new moon while muttering such and such an incantation, then. . . ."

During nearly a decade in which I worked for one of the leading computer industry market research firms (I was a senior vice president when I resigned nearly three years ago), I was frequently appalled by much of what passes for market research. All too often, such research proves the old saying: In the kingdom of the blind, the one-eyed man is king.

Since I am now merely a consumer of market research, I'm no longer concerned with actually *doing* market research (and thankfully so). I focus instead on industry and market analysis. Surveys are raw material for my primary task: trying to understand what is really going on in the industry and what it means. And yes, having seen the sausages made, I know better than to believe uncritically the "results" of what is sometimes claimed to be market research. I know only too well how insubstantial and inaccurate much of it really is.

My main source of industry information is direct observation in one form or another. I visit with users, vendors, and members of the financial community. I study reports and conversations on PC MagNet and CompuServe, and learn from direct experience in trying out new hardware and software. I also maintain contacts at trade shows. These, and the like, are my most trusted ways of taking the industry's pulse.

Though these sources provide a tremendously useful foundation and are often sufficient in themselves (if interpreted correctly), quantitative information from broad-based surveys—if reliable and accurate—is even better. I am always grateful to find a soundly done market survey that is *not* of the "kill the chicken" variety.

It was therefore with considerable delight that I read a recent study of *PC Magazine* subscribers done by the Ziff-Davis Research Department and Alpert Research Inc. Based on responses from 1,840 *PC Magazine* readers (from a mailing of 3,000—a 62 percent response rate) it was one of the best designed, best executed, and most useful market research studies I've seen in a long time.

This very well-conducted study offers valuable insight into what is really going on in the world of microcomputers, with regard to operating environments. It shows that the true horizon of possibilities for the near future is quite different from what many have assumed it to be.

Respondents who personally used or were familiar with *Windows* 3.0, OS/2, Unix, and the Mac were asked to rate factors that encourage them to buy or discourage them from buying these operating environments. Ratings were made on a seven-point scale ranging from plus 3 ("would encourage to buy") to minus 3 ("would discourage to buy") with 0 as a neutral middle point.

ILLUSTRATION: STEVE DINGING

I had not seen the results of this study when I wrote my column for the previous issue of *PC Magazine*, in which I said that rumors of OS/2's death were greatly exaggerated. Any lingering doubt I might have had on that score was thoroughly dispelled by the results of the survey.

Respondents who personally used or were familiar with *Windows* strongly confirmed that it is *Win* 3's memory management, multi-

tasking, and extended memory capabilities that make it most desirable to them. GUI capabilities and the availability of *Windows* applications are, relatively speaking, of only secondary importance.

In all, 58 percent gave an extreme (+3) rating to "memory management" as a reason to buy *Windows* 3.0, while 55 percent gave "multitasking ability" and "uses extended memory" a comparably high rating. Only 38 percent cited "graphical interface" and an even smaller 26 percent named "availability of *Windows* applications" as equally important (+3) factors encouraging the purchase of *Windows* 3.0.

All of this strongly supports my contention that *Windows* 3.0's success is due more to its usefulness as a reasonably good DOS memory manager and multitasker than to any ground swell of support for GUIs or *Windows* applications. The study results also corroborate my observation that sales of *Windows* applications lag far behind reported sales of *Windows* 3.0 itself.

Respondents who personally used or were familiar with OS/2 indicated—with equal clarity—that multitasking, memory management, and access to extended memory are already OS/2's key strengths. They also reported, however, that the primary obstacle to OS/2 acceptance so far has been its limited ability to run DOS applications well.

A staggering 54 percent of respondents who were familiar with OS/2 cited OS/2's limited ability to run DOS applications as *the* major factor (-3 on the scale) that would discourage them from buying or recommending OS/2. By contrast, only 12 percent cited lack of OS/2 applications as an equally important factor in discouraging purchase of OS/2.

This recent *PC Magazine* reader study provides very strong quantitative support for my previous, mostly qualitative, judgment that effective multitasking of DOS applications is the "critical success factor" that *Windows* 3.0 has, but that OS/2—prior to OS/2 2.0—has lacked. The study supports, therefore, my contention that OS/2 2.0 (and the Presentation Manager API along with it) has a greater chance for success than most recent observers have given it credit for.

As the study shows, fundamental conditions for the major success of OS/2 2.0 and PM are in place. That's provided, of course, that OS/2 2.0 delivers on its promise. It must not only provide the full power of a true multitasking kernel and expanded memory management, but also do an even better job of running multiple DOS applications than *Windows* does. If OS/2 2.0 can do all the things that *Windows* does, but even better, then OS/2 can mount a strong challenge to *Windows*, particularly on more powerful Intel 386- and 486-based systems.

I think that it will. The struggle for the office desktop is far from over, and OS/2 (and PM with it) is far from dead. And as you might expect, considering the quality of *PC Magazine*'s audience, the recent survey of our subscribers goes a long way toward showing why. ■

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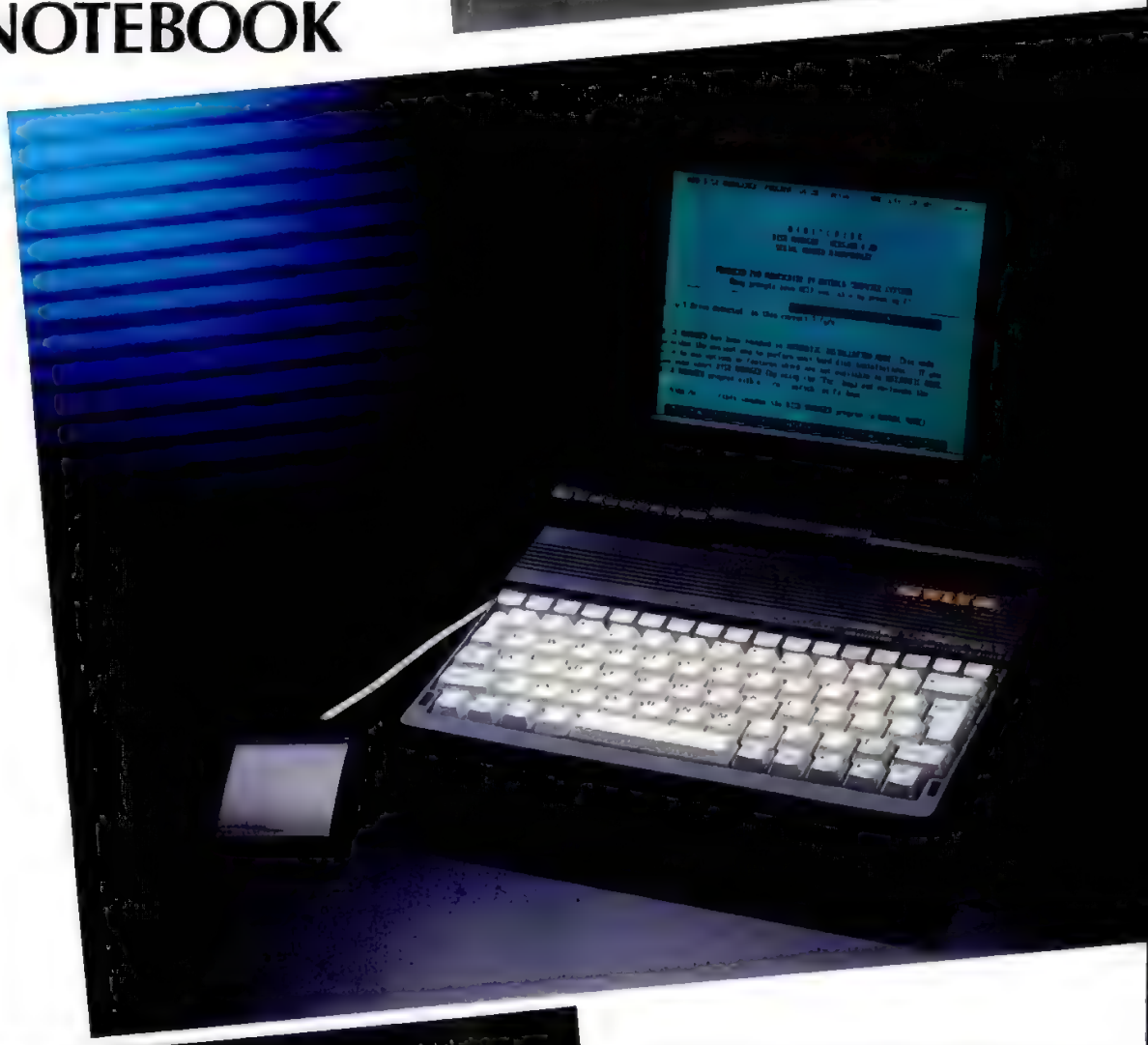

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CIRCLE 134 ON READER SERVICE CARD

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Backup Software Gets Better

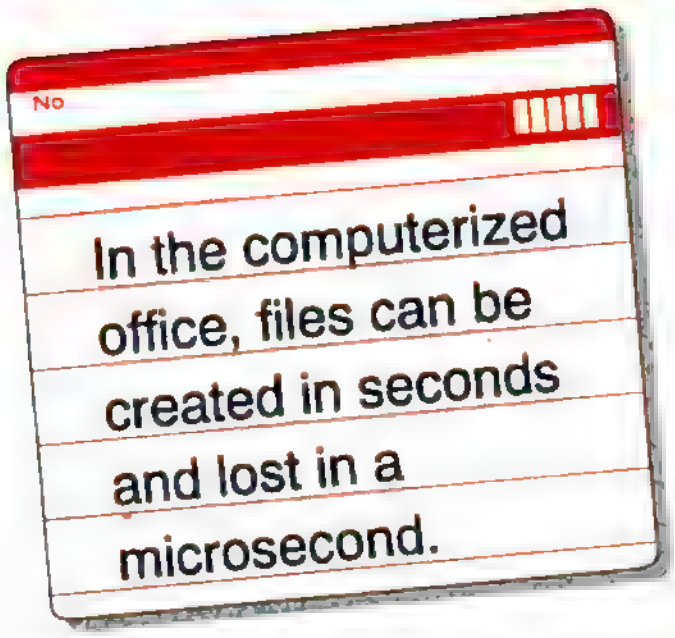
Don't just hope that your hard disk will never fail! Take steps to protect your data. PC Magazine Labs tests 11 backup packages ranging in price from $49 to $225 and finds them faster and easier to use than ever.

by Edward Mendelson

You only need to lose one file to become a true believer in backups. In the precomputer era office, files on paper took a long time to create but tended to last forever. In the computerized office, files can be created in seconds and lost in a microsecond. A hard disk failure, a mistaken DEL command, a distracted worker who overwrites a long file with a short one that has the same name—all these common occurrences can make you lose a file as thoroughly as theft, fire, or flood.

As soon as IBM introduced its internal hard disk in the original XT in 1983, backups became a necessity. DOS 2.0, also introduced with the XT, included the first of DOS's notoriously slow and awk-

PHOTO: THOM O'CONNOR; MODEL CONSTRUCTION: GRAPHICS FOR INDUSTRY



ward backup programs (see the sidebar "Backing Up with DOS"). Third-party vendors didn't need to be told that faster and easier alternatives would sell by the thousands. Today, most backup programs are so fast, sleek, and reliable that no one has an excuse for using DOS's second-rate backup program or not using any backup at all.

As hard disks increased in size, IBM increased floppy disk backup capacity. Before long, even 1.44MB floppy disks were too small for practical backups of the giant hard disks that became standard in many standalone and network settings. For backing up large disks, tape drives have been established as the standard backup medium. Cartridge drives with 150MB to 300MB capacities are now standard equipment on well-equipped machines, and DAT (digital audio tape) drives with capacities measured in gigabytes no longer seem exotic.

In this evaluation, PC Magazine Labs tests 11 backup packages that write to floppy disks, to tape drives (which normally are not accessed by a DOS drive designation), or to DOS devices—meaning anything that you can access with a drive letter, including a hard disk on a network server, removable devices like the Bernoulli Box or transportable hard disks, and a few tape drives. These 11 packages are *Back-It 4, BakupWiz, Central Point Backup, Diskpack, DMS/IB Intelligent Backup, Fastback Plus, The Norton Backup, PC-Fullbak Plus, SitBack, Sytos Plus File Backup Manager*, and *TakeTwo Manager*. Programs that back up only to floppy disks were excluded, and in case you're wondering where to find Core International's well-known *COREfast* in this roundup, Core representatives report that they have stopped distributing it.

Each of the packages tested here allows you to use the same backup software for floppy disks and for larger storage devices; each deserves consideration for office and personal use. Many tape drives come with their own proprietary software, which can be used only with the right drives, but programs like *Central Point Backup* and *Back-It 4* support these drives and can be used as substitutes for the proprietary software. Some other major backup packages will include extensive tape support in new versions (due around the time you read this), and *Sytos Plus*, which is supplied with many tape drives instead of proprietary software, supports floppy disks as well as tape.

PC MAGAZINE EDITORS' CHOICE

• *The Norton Backup*

The newest major backup package is also the best. *The Norton Backup* transfers files dramatically faster than its competition, has better safety features and error correction for dealing with real-world disasters, and offers the most useful features for building a corporate backup strategy. Its advanced customization, combined with its "Preset" menu level, make it suitable for experts and casual users, and its automatic command-line restores add to its convenience. Virtually the only significant missing feature is tape backup support, which is promised for the next release.

Fastback Plus, a previous Editors' Choice, remains a fast, safe, and highly capable performer and deserves a most honorable mention. Nevertheless, the version we tested didn't handle multiple partitions easily and had limited facilities for including or excluding files. Fifth Generation Systems plans to ship an entirely new Version 3 of *Fastback Plus* with a wealth of new features this spring. Be sure to buy that version, and you won't be disappointed.

DMS/IB Intelligent Backup, also a previous Editors' Choice, deserves honors for its intelligent disk-preserving backup strategy, but its speed and flexibility now fall behind the best of the competition.

GETTING INTO A BACKUP ROUTINE

The simplest way to ensure that all your files are backed up is to perform a full backup—one that copies all the files on your disk. However, because most files don't change between one backup and the next, you will only waste time if you perform a full backup daily. Between full backups you normally perform smaller "incremental" backups that copy only those files you've created, copied, or modified since the last backup.

DOS uses a simple but effective trick to help you perform incremental backups. The directory entry for all files includes an archive bit, which functions like the flag on a rural mailbox. If a file's archive bit is switched on, then a backup program knows that the file has not been backed up, and will copy it during an incremental backup and then switch the archive bit off. If a file's archive bit is switched off, the backup program will ignore the file until the next full backup. Some backup programs, which use their own record-keeping instead of the archive bit, also support "differential" backups that transfer all files created or modified since the last full backup, even if they have been copied during an incremental backup.

Before you perform your first backup you should devise a backup strategy that will combine safety and convenience. One classic strategy calls for three separate sets of backups, each made in successive weeks. On the fourth week, you reuse the disks from the first set, so that you still have the security of two complete sets of backups in case something goes wrong during the fourth backup. On the fifth week, you reuse the disks from the second set, so that you constantly maintain two earlier backup sets in addition to the current one. Other backup strategies can call for daily incremental backups between weekly backups. If your backup program includes an automatic scheduler and you back up to tape or to a network server, you can arrange for unattended backups in the middle of the night.

SPEED PLUS COMPATIBILITY

A few years ago many high-speed backup programs achieved their highest speed by formatting floppy disks in a proprietary way that DOS couldn't read. A few programs, notably *Central Point Backup* and *The Norton Backup*, still allow you to use proprietary formatting as an option, but DOS-compatible formatting has increasingly become standard as programmers

find ways to boost speed while retaining compatibility.

Many backup programs still insist that you use a fresh floppy disk whenever you start a new backup, even though DOS-compatible formatting theoretically allows the program to append a small incremental backup to a disk already partly used by an earlier backup. One disk-saving workaround available in almost all programs, although almost never documented, involves writing to a generic DOS device that happens to be called drive A: or drive B: instead of to the disk drive of the same name. Backup programs generally use a technique for writing to generic DOS devices that is different (and slower) than the technique they use for writing specifically to floppy disk drives, and these generic techniques allow appending backups to floppy disks already used.

Almost all backup packages now include compression techniques that can squeeze large files into small spaces. If you're using a slow XT- or AT-class machine, compression normally slows down a backup, and you may want to test whether you get faster backups by turning it off. On fast machines, especially 20-MHz or faster models, compression seldom exacts any timing penalty and should almost always be turned on.

ELEVEN PROGRAMS TESTED

PC Labs timed each program's ability to back up 11MB of data to unformatted 1.2MB floppy disks. We also tested the speed of each of the three fastest programs when backing up to floppy disks that the same program had formatted in a previous backup. We did this to see whether the speed rankings of the programs would be the same both ways, and they were.

PC Labs also inflicted a series of deliberate disasters on each of these programs to see how gracefully they recovered, including damaged disks or disks with capacities different than what the program expected. Some of the results were surprising, with well-regarded packages permitting fatal losses of data in real-world error conditions.

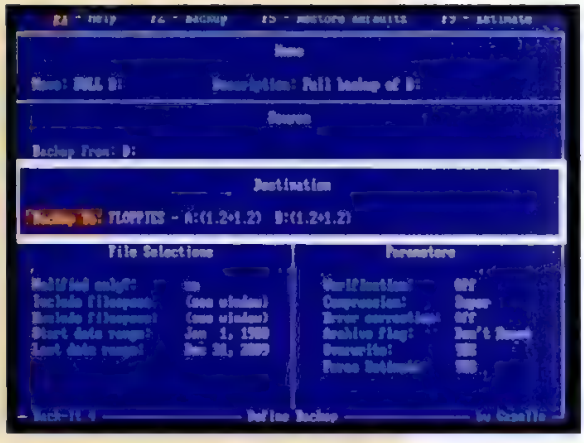
Many packages, however, performed very well. One or more of these 11 backup programs probably offer the exact combination of features and security that you need—and that your data deserves.

Back-It 4

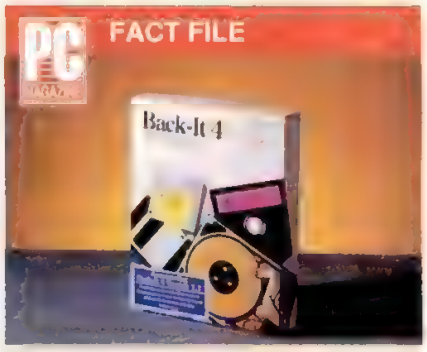
by Edward Mendelson

Back-It 4, Version 4.1, gets the job done quickly and automatically, with plenty of customization options and control over backups and restores. Gazelle Systems' $169 package would have been spectacular only a couple of years ago, and set against 1991's competition, it still looks quite impressive. You can find almost all its features in programs that work more quickly, but there is a chance that *Back-It 4* will prove to be the only program with the exact set of features you need most. If so, its safety features and flexible configuration will make it a choice you won't regret.

If you want to back up from multiple partitions in a single backup operation, *Back-It 4* makes the job easy, and it's one of surprisingly few programs that do so.



As you move through the menus in *Back-It 4*, a brightly outlined window moves with you. You can specify any number of source drives and modify include/exclude specifications by tagging from a submenu.



***Back-It 4*, Version 4.1**
Gazelle Systems, 42 N. University Ave., Provo, UT 84601; 800-233-0383, 801-377-1288.
List Price: $169.
Requires: 384K RAM, DOS 2.0 or later.
In Short: A solid and flexible backup program with support for SCSI drives that aren't supported elsewhere and good error handling. Confusing menus and a few missing options are its main weaknesses.

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You tag drive letters from a list and then optionally tag or untag directories from a directory tree. You can't tag individual files to include or exclude, but you can enter up to 16 file specs in a separate window.

You can store up to 51 backup configurations and run a configuration automatically by using its name as a command line parameter. The screen that displays your configuration also lists the date of the most recent backup of that configuration. *Back-It 4* performs full or incremental backups but does not let you perform differential backups.

You can perform a "direct backup" that you configure, instead of using a preset configuration, but a direct backup doesn't create a log file. If you want to change restore parameters during a restore—for example, turning the overwrite prompts on or off—*Back-It 4* lets you press a function key and make the change without starting again.

You can use *Back-It 4* to back up to floppy disks, DOS devices, tape drives (including QIC-40 or QIC-80 models), QIC-150 SCSI hard disks, or Hewlett-Packard DAT drives that use the Western Digital WD7000 SCSI board. Backup disks are formatted to be readable by DOS, although files can be re-

stored only by a copy of *Back-It 4*. A 2K memory-resident scheduler can run any preset backup configuration at a specified time, although unlike *Central Point Backup*'s scheduler, the backup program will start up only if you're at the DOS prompt. Gazelle Systems claims to use proprietary tricks that speed backups from a workstation to a Novell server.

MENU CHOICES

Everything in *Back-It 4* is controlled from an elaborate menu system that's more inclusive than clear. Many screens are divided into regions that you move between using the arrow keys; you can use first-letter shortcuts to jump to another option in the current region, but not to options in other regions. Few screens resemble each other, and in almost every screen the list of keys you can press to manipulate menu fields appears in a different spot.

The context-sensitive help screens sometimes confuse matters further, because the function keys that explain the various features once you're in the help screens are different from the keys you use to access those features in the program. The manual, which is organized according to the menus rather than procedures, helps sort out the more confusing screens.

QUICK RESTORE

Back-It 4 performed respectably, if not spectacularly, on PC Magazine Labs' speed tests. It backed up 11MB of files in 8 minutes 52 seconds and squeezed them onto six 1.2MB floppy disks. The program needed only 3 minutes 33 seconds to restore the files—one of the fastest results in the testing.

Its error handling was so effective, that when it was given a 360K floppy disk instead of the 1.2MB floppy disk for which the program was configured, it managed to format and use two tracks on the disk, and successfully restored the files written to those tracks. When we purposely damaged a disk in a backup set and tried to restore from it, the program first tried to use error correction, then reported the exact location of the uncorrectable damage in the file, and finally asked if we wanted to retain the part that it could salvage.

Back-It 4 is a worthy but unspectacular performer that offers a fairly complete but uninspiring set of functions. It won't dazzle you with its speed or features, but if you need a program that supports multiple partitions in a single backup operation, it won't disappoint you.

BakupWiz

by Greg Pastrick

Speed is such a critical factor in backing up and restoring data that when a program is either notably fast or unusually slow, it forms your primary impression. The $59 *BakupWiz*, Version 2.15, from PCX, ranks second-to-last on PC Magazine Labs' speed tests, and although it is more sophisticated than a basic backup package like *Diskpack*, it lacks some conventional features and conveniences.

BakupWiz supports network use where multiple backup strategies are needed for different levels of user experience. Its *1-2-3*–style interface has various message and status windows to keep you informed. *BakupWiz* also uses a graphics device, which PCX calls a "light bar," that extends across the bottom of the screen to specify the amount of backup and restore in progress.

You can run full file-by-file backups, full backups of modified files, selected file backups, or selected modified file backups, and designate up to 32 file specs for individual files, groups of files, and directories. The only time option available is a backup and restore of modified files after a defined date and time. *BakupWiz* has limited on-line help and creates a log file during backup that serves only as a verification of the backup and restore status. In our tests, we discovered that the log for a backed-up file will indicate that the file contains zero bytes of information. PCX concluded that the problem is caused by a simple oversight in the program's code.

***BakupWiz*, Version 2.15**
PCX, 4874 Alberson Ct., San Diego, CA 92130; 619-259-9797.
List Price: $59.
Requires: 256K RAM, DOS 2.0 or later.
In Short: With plodding backup speed and limitations in its feature set, *BakupWiz* is outstripped by its competitors, even though its shareware price is attractive.

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UNINSPIRED TEST RESULTS

BakupWiz's plodding automatic format procedure takes about 1 minute 20 seconds per disk, which is even slower than the average manual format we timed at 1 minute 11 seconds using DOS 4.01. On PC Labs tests, *BakupWiz* clocked in at 22 minutes 2 seconds and used ten disks to back up approximately 10MB of data. *BakupWiz* outperforms only *DMS/IB Intelligent Backup* and trails all the other packages we tested.

On Restore tests, the program bests three competitors but is still over 7 minutes slower than the fastest of the group, *The Norton Backup*. Documentation offers little in the way of settings to optimize backup or restore speed except a comment, "The bigger the buffer, the faster the backup."

BakupWiz is not precise with its error

***BakupWiz* isn't nearly as full-featured or advanced as the best of its competition. This simple screen in which you type the names of files you'd like to back up is typically austere. The video mode default is set to 43 lines.**

messages, which we discovered in the course of torture-testing *BakupWiz* to evaluate how it handles events that confuse backup and restore processes. The package has a tendency to hang up and abort to the operating system when confronted with trouble. For example, when we altered the sequence of the backup disk during file restores, the program displayed an "Unrecoverable error on media" message and eventually dropped to DOS. It's also too easy to overwrite disks during backup if you fail to insert a new disk when prompted. This needlessly complicates an already time-consuming procedure, especially if the backup needs to be rerun because you overwrote disk number seven out of a set of ten.

Like *Diskpack*, *BakupWiz* is shareware-priced, and you can download it from information services such as CompuServe. Though the software does offer Novell server support, password protection, and some mildly appealing status displays, it's slow and limited.

Central Point Backup

by Edward Mendelson

You may already own a copy of *Central Point Backup*, Version 6, without knowing it. Central Point's $99 backup utility is the same as the backup module included in the ubiquitous *PC Tools Deluxe*, Version 6. With the separate release of the backup program, Central Point introduced some improved features and a handsome, colorful new screen that makes this the best-looking backup program on the market—and one of the fastest. It's also the first backup program to support the QIC-40 and QIC-80 tape drives, which aren't accessed via a drive letter and therefore aren't DOS devices. It even supports tape drives that use special controller cards like Mountain Computer's Mach2.

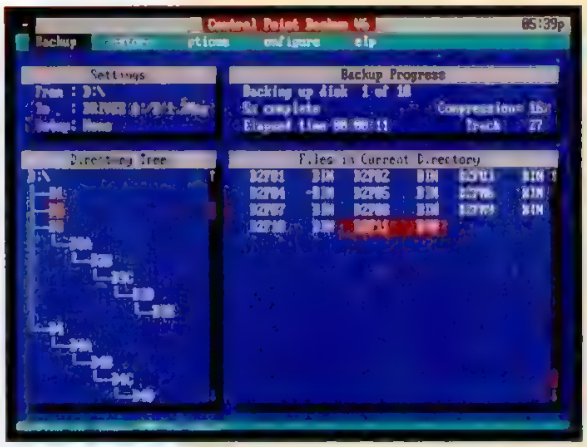
Only a few missing conveniences and safety features keep *Central Point Backup* from the top rank of backup programs, but Central Point Software promises to repair those omissions in Version 7, which is due to ship this spring.

MEMORY-RESIDENT SCHEDULER

Like most of the modules in *PC Tools Deluxe*, *Central Point Backup* offers an impressive combination of standard and innovative features. Many other backup programs offer scheduled backups that run automatically on an unattended computer. *Central Point Backup* goes one step further. Its 4K memory-resident scheduler does not require the computer to be idle at the DOS prompt when the backup begins. A pop-up screen warns that you have 15 seconds to cancel the backup, saves any application you have in memory, runs the backup, and restores the application. I used it successfully with half a dozen programs stored in expanded memory using *WordPerfect Library*, but it deliberately doesn't try to interrupt *Microsoft Windows* or other programs that use protected mode.

Virtually every standard function you expect to find in a backup program is included in *Central Point Backup*, although sometimes with an unexpected twist. You can set the range of options on the menus to beginner, intermediate, or advanced levels, and you can lock backup sets with a password.

You can save customized setups that include your list of files to include or exclude, plus any of the program's full range of formatting and compression options. You can select files and directories to include or exclude by tagging them on a convenient directory tree, or you can type up to 16 file specs in a single window used for both included and excluded files.



The colorful main screen of *Central Point Backup* combines CUA-compliant pull-down menus with a detailed progress display that includes a report on the degree of data compression used on each file.

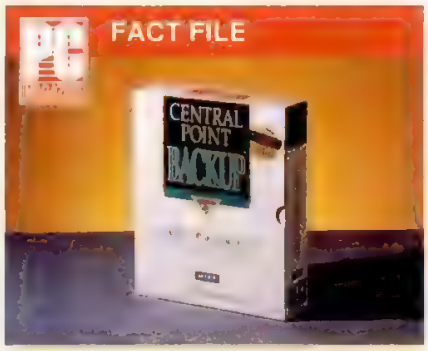
The twist is that only the files and directories typed in the window are saved with your setup file. The ones you tag on the directory tree aren't saved and must be retagged each time you use the program. Another twist is that while you can enter and save file specs from multiple drives in the include/exclude window, it ignores any file specs in the include/exclude window that specify a drive different from the one named in a separate Backup From option.

To process more than one drive, you have to switch the source drives from a menu or load a new setup. You can automate the process by saving a different setup for each drive, and then write a batch file that runs the program repeatedly with a different setup as a command line parameter.

The manual says that another command line parameter lets you restore files automatically without going through the menus, but you have to use the menus anyway. Central Point acknowledges that the manual is misleading and claims that command line restores will work correctly in Version 7.

PROPRIETARY FORMAT

On PC Magazine Labs' speed tests, *Central Point Backup* transferred 11MB to unformatted floppy disks in 6 minutes 14



***Central Point Backup*, Version 6**
Central Point Software, 15220 Northwest Greenbrier Pkwy., Beaverton, OR 97006; 800-888-8199, 503-690-8090.
List Price: $99
Requires: 512K RAM, DOS 3.0 or later.
In Short: This is one of the fastest and sleekest backup programs, providing extensive support for popular tape drives and an optional TSR scheduler that can interrupt an application to run a backup. Problems include limited flexibility in file selection and dangerously weak error handling. Both problems should be corrected in Version 7.

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seconds, and restored in 2 minutes 45 seconds—speeds outperformed only by *The Norton Backup*. When backing up to disks already formatted with the program's proprietary format (which is completely unreadable by DOS), the backup took 3 minutes 35 seconds, a few seconds longer than *Fastback Plus* on a similar test. Data compression, with both the Save Time and Save Disks options, packed the files onto six 1.2MB floppy disks—one more than *Fastback* and *Norton*.

The program fared less well on PC Labs' error-handling tests. On one test, we used a 360K floppy disk instead of the 1.2MB disk the program expected, and it proceeded to write to the disk as if nothing were wrong—even with the verify option switched on. When we tried to restore from the low-density disk the program was unable to read anything from it and every file on the disk was lost.

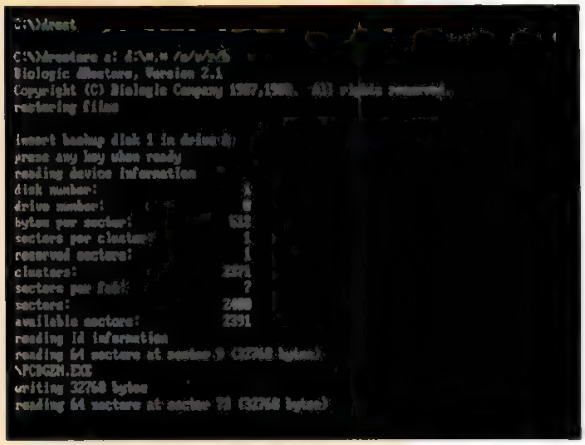
Because it's impossible to tell visually whether an unlabeled 5.25-inch floppy disk is high-density or low-density, this potentially disastrous error could easily occur in the real world. A less serious error occurred when we opened a drive door during a backup, and the program displayed an error message saying the disk was write-protected.

Central Point promises that all these errors and other limitations will be fixed in Version 7. The new version will also include virus protection, a setup translator that lets you use *Fastback* and *Norton Backup* setup files with *Central Point Backup*, and full compatibility with a *Microsoft Windows* version due for release at the same time. The *Windows* version will make it possible to back up your data while running another application—potentially the most significant time saver ever introduced in a backup program, and another example of the innovations that an enormous user base has learned to expect from Central Point.

Diskpack

by Greg Pastrick

As a simple $49 replacement for the BACKUP and RESTORE utilities offered by DOS, Biologic's *Diskpack*, Version 2.1, fulfills the promise of performing these tasks faster and with fewer disks than DOS. Beyond that, *Diskpack* is no match in features, options, and speed for the more costly, more powerful packages we tested.



Upon completion of a file restoration, *Diskpack* updates the screen to show the totals for bytes read, bytes written, files copied, disks used, and any errors. Comparison of the backup with the *dRestore* source may be accomplished with the omission of /r (for restore) from the command string.

Diskpack's single installation disk comes with two executable files, *Diskpack* and *dRestore*. You activate these operations from the DOS prompt by entering the appropriate utility name and the parameters for the desired backup or restore. For example, entering DISKPACK d:*.* a:/a/b/h/s/v directs the program to perform a complete file-by-file backup of drive D:, to leave the archive bit unchanged, to activate a beep prompt to insert the next disk, to back up hidden files and subdirectory files, and to display the screen of the backup in progress.

BASIC SCREEN DISPLAYS

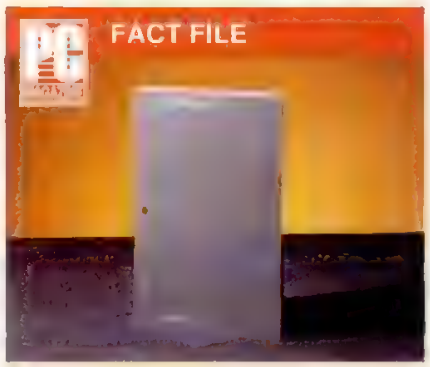
Even with the /v parameter inserted in the command statement, *Diskpack* has a plain, character-based interface that displays basic disk activity during backup, including information about the disk, its sequence in the backup, and the sectors and files being written to it.

After *Diskpack* completes the backup, it updates the screen to show total bytes read, bytes packed, bytes written, files copied, and disks used. You'll want to omit the /a parameter from the command string to allow the program to recognize modified files on subsequent backups.

Use of the /c parameter in the string also directs the program to create a catalog file so you have a record of the process, which can be an indispensable aid in restoration of individual files. You can read this directly from DOS using the TYPE command or from *dRestore* using the /d parameter.

Unlike all of the other packages reviewed here, *Diskpack* requires preformatted disks, and its proprietary file-compression technique achieves good disk savings without seriously affecting speed. For full backups, you cannot alter optimal compression or speed, except for the exclusion from the command line of backup-interrupting parameters such as /p and /w. These parameters display a yes/no prompt before copying and prompt the user to press a key before reading a source file. It's recommended that the CONFIG.SYS file has a buffers=16 statement.

On PC Magazine Labs' tests, *Diskpack* took 6 minutes 25 seconds to back up 10MB of test data from our source drive to seven disks. This time does not include the estimated 1 minute 11 seconds per floppy disk required to format the disk set under DOS 4.01. Inclusion of the time needed to format the disks manually increases backup timing up to about 13 minutes 42 seconds and positions *Diskpack* within the performance range of *PC-Fullbak* and *Sytos Plus*.



***Diskpack*, Version 2.1**
Biologic, 7950 Blue Gray Circle, Manassas, VA 22110; 703-368-2949.
List Price: $49.
Requires: 320K RAM, DOS 2.0 or later.
In Short: This low-cost shareware package may be attractive to users without elaborate backup demands, but it is too limited for anything other than basic backup and restore operations.

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UNCOMPRESS AND RESTORE

Due to its routine to uncompress backup files, *Diskpack* was one of the slower programs we tested in restoring files to the target test machine. The program took 11 minutes 59 seconds to restore the seven disks of backup material from the source drive.

dRestore also requires you to specify command-string parameters to perform the desired file restoration. Interestingly, you must specify the /r parameter, for restore. *dRestore* without /r performs a file comparison between the backup disks and restored target drive, but will not back up files.

The look and feel of *dRestore* is nearly identical to that of *Diskpack*'s backup utility. You get the same readout of the program's activity, in addition to an accounting of errors or bad files introduced during the restore process. Use of the /p1 and /p2 parameters prompts you to verify hidden or modified files and all files for restoration, respectively. *dRestore* restores a file or group of files only to the same directory they were in when *Diskpack* copied them. To its credit, though, the program works around disk sequence and allows restoration of data from anywhere in the backup disk set.

Under the fire of our routines to introduce errors, *Diskpack*'s response was to abort to DOS. Generally, this would not be considered a bad response when a badly damaged disk is introduced or when backup and restore operations have been forcibly interrupted. However, other packages we evaluated were able to handle such dirty tricks in more elegant ways by attempting to continue despite adversity and alerting the user with more-specific error messages.

While *Diskpack* is a fine package for simple backup and restore operations and is more efficient than DOS's utilities, functional limitations put it at a distinct disadvantage for anything more than personal use.

BACKING UP WITH DOS

by Barry Simon

Plenty of companies other than Microsoft have made lots of money from DOS—which has been marked as much by what it lacks as by what it features. The backup packages evaluated in this roundup exist only because DOS gave them something to exploit.

While not as bad as EDLIN, the backup facilities in DOS have been weak from the start. Since backing up is a fundamental part of computing, you'd think that the designers of DOS would have lavished their efforts on improving BACKUP/RESTORE. But the improvements made from DOS 2.0 (where BACKUP was added) through DOS 4.0 have been minimal.

AN EVOLUTIONARY NEED

BACKUP wasn't needed in DOS 1*x* because the first PCs didn't have hard disks, and the COPY command sufficed. DOS 2.0, released to support 10MB hard disks, needed, as a minimum, some method to back up files that were too big to fit on a single floppy disk. To this day, that's a major use of the BACKUP command, especially since using BACKUP in such cases is preferable to using the COPY or even the XCOPY command introduced in DOS 3.2.

Since DOS 2.0, the archive bit associated with each file has been an important part of DOS, a part used by its backup programs and by all third-party backup programs. Whenever a new file is created, copied, or modified, the file's attribute bit stored in the directory is turned on. Backup programs will turn it off so that the files modified since the last backup are only those with their archive bits turned on. DOS BACKUP has the option of doing partial backups of only those files with their archive bits set from the start.

DOS 3.0 was introduced to support the IBM AT, which could be configured with two hard disks. You might have expected that this version of BACKUP would allow users to back up from one disk to another, but the ability to restore a backup on a hard disk wasn't introduced until DOS 3.1.

DOS BUGS AND GOTCHAS

BACKUP/RESTORE has been notorious for its share of bugs, but those in DOS 3.3 were particularly bad. First DOS 3.3's RESTORE couldn't read DOS 3.2 backups because directory names for Version 3.2 used the forward slash as the pathname delimiter, while DOS 3.3 and later versions use the more usual Backslash. In addition, the syntax for RESTORE was changed with DOS 3.3. Previously, if you wished to restore the files in the directory C:\stuff\files, you could use

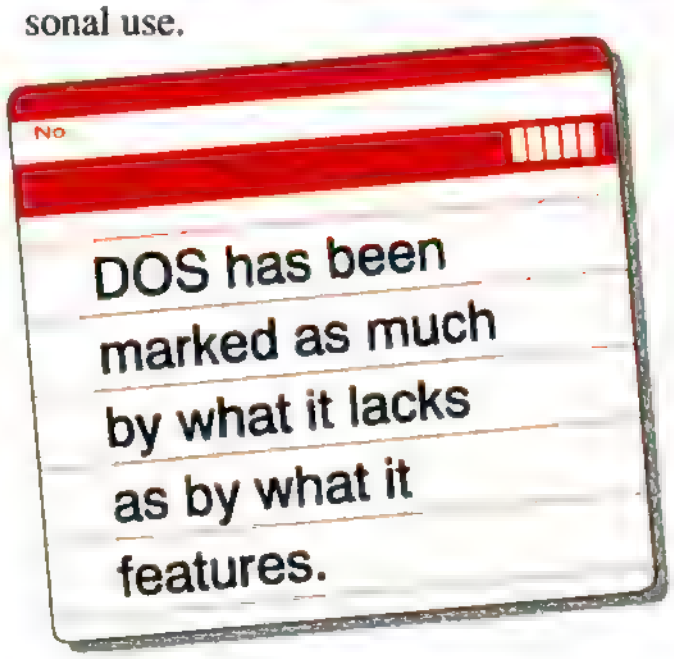
```
restore A: C:\stuff\files
```

If you tried that with 3.3, you'd get the error message "Warning! No Files were found to restore," which is hardly informative. In fact, you needed to use

```
restore A: C:\stuff\files\*.*
```

Perhaps the worst fiasco in BACKUP's history is the following, taken from an official Microsoft document: "The MS-DOS, Version 3.20, RESTORE command may not always restore files backed up with the Version 3.20 BACKUP command. Microsoft has confirmed this to be a problem in MS-DOS, Version 3.20."

Bugs and glitches aside, the biggest problem with DOS BACKUP is the time it takes to preformat floppy disks, since DOS versions prior to 4.0 don't allow format and backup in one operation. It also takes time to learn an arcane command-line syntax, time to shuffle floppy disks because there is no file compression to cut down on the number of floppy disks needed, and time to wait because DOS's backup speed is not a match for any of the third-party backup packages available in today's marketplace. ■



DMS/IB Intelligent Backup

by Edward Mendelson

You won't buy Sterling Software's $149 *DMS/IB Intelligent Backup*, Version 3.23, for its speed or its ability to manage highly customized or complex backup procedures, but you may buy it for its ability to maintain a compact and up-to-date set of backups without any intervention from you. You may also want it for its ability to restore files with the least possible effort when you specify the filename as a command line parameter.

DMS/IB backs up to disks or any DOS device that uses a drive letter, but it applies its intelligence most effectively with disks. Other backup programs let you decide whether to accumulate or recycle your old backup sets. *DMS/IB* organizes a customizable backup system for you that effectively warehouses your older files while continually updating your newer files, thus maintaining your backups on a consistent and limited number of disks. *DMS* stands for Disk Management System, and you may want to take a deep breath before trying to understand the program's complex system. Once you get the essentials, the details are easy.

INTELLIGENT DISK MANAGER

The package takes care of most details by itself. When you set up the defaults, you specify two options not seen in other programs. One sets the number of days after which an unmodified file should be considered "old"; the other sets the number of disks in a backup "pool." When you first make a full backup, the program places files on separate disks depending on whether they count as "old" files or new ones. (The default cutoff is 45 days, but you can change it.) You never have to touch the disks that hold the older files unless you need to restore your entire hard disk.

The next time you run the program, it backs up only new or altered files. These incremental backups are appended to the existing disks that contain your newer files until, probably after a month or so, you approach the last of your "pool" of backup disks. At this point, the program suggests that you run a "Consolidate" backup that replaces the accumulated incremental disks with two sets of disks: one that contains files aged to the point of becoming "old" files, which are now warehoused, and a set with newer files.

You then append incremental backups to this set of newer files until the disk pool is nearly exhausted. For safety, you can tell the program to maintain two or more sets of backups, so that you'll lose nothing when the program writes a Consolidate backup over earlier incremental backups. You can number the disks with a set of supplied labels and use a built-in utility for printing additional labels.

The benefit of this system (which you can modify or override at any time) is that you always have a current backup set without backing up your whole disk every few weeks or accumulating an endless series of incremental backups. *DMS/IB* also economizes on floppy disks by starting a new backup on the space left on the last disk used.

The program even keeps track of files you have deleted from your hard disk, and if you ever have to restore the disk, you'll be prompted before restoring a file that you've already deleted. One potential disadvantage is that the program marks a file as "old" by changing the seconds field in its directory entry to 62 seconds; no application uses this field, but Sterling Software warns that some virus-checking software might report an infection when it encounters the altered entry.

CONFIGURATION LIMITATION

If everything in *DMS/IB* were as elegant as its disk-saving strategy, it might be the best package on the market. Unfortunately, its file selection menu lacks shortcuts found in other programs (although you can save time by editing the file selection list in any text editor), and it doesn't let you back up from more than one partition at a time. You can save only one default configuration, and if you don't want to change it manually to process a second drive, you have to write a batch file that runs the program twice, once with each drive letter as a command line parameter.

DMS/IB Intelligent Backup **presents all its main options on a single screen that lets you customize its unique backup strategy. One option lets you maintain multiple backup sets automatically.**

DMS/IB is also relatively slow. With its most powerful compression option turned on, it needed 17 minutes 15 seconds to back up 11MB to seven 1.2MB floppy disks. Restoring was also ponderously slow at 10 minutes 12 seconds. The program's error handling was effective but not as helpful as it might be. It indicated that we had inserted the wrong floppy disk in a restore but couldn't tell us which was the right one.

Many of the current version's limitations are remedied in a solid beta version that Sterling makes available to customers who need its features. The improvements include support for multiple drives in a single backup and more flexibility in

***DMS/IB Intelligent Backup*, Version 3.23**
Sterling Software, 11050 White Rock Rd., Rancho Cordova, CA 95670; 916-635-5535.
List Price: $149.
Requires: 380K RAM, DOS 2.0 or later.
In Short: This unique backup system recycles and warehouses floppy disks to maintain a current backup set with minimum effort and minimum waste of floppy disks. Slow speed and limited flexibility mar an otherwise elegant package.

CIRCLE 427 ON READER SERVICE CARD

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INTRODUCING GATEWAY'S

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ROOM FOR EXPANSION

Due to their reduced size, many small footprint computers are short on expansion slots. We addressed this problem by integrating the floppy drive controller, the video chip set and the I/O card on the motherboard, leaving five 16-bit slots open in the standard configuration. Our mini desktop systems also have a standard mouse port (PS/2 compatible), leaving two serial ports open.

HIGHER PERFORMANCE

The Gateway 2000 286 system operates at 16 MHz, rather than 12 MHz, for better performance. Our 386SX is available as a 16 MHz or a 20 MHz system. The 386SX-20 includes a 32K cache, which makes this system another truly outstanding Gateway price/performer.

BETTER-THAN-EVER VALUE

Possibly the most dramatic news about our new mini desktop systems is their prices. When a manufacturer introduces a new product line, you expect to see an eruption of price hikes. But then you've come to know Gateway is not like most manufacturers. Prices on systems in our new line are better than ever. And that goes for quality and service too, making the hottest value in the industry even hotter.

Little Spitfire Systems

INTRODUCING GATEWAY'S FI

HOT-PERFORMANCE 386 AND 486 SYSTEMS ARE IN ICY GRAY, CURVILINEAR MODELS

Although Gateway's 386 and 486 systems look entirely new, we limited changes on the inside to fine-tuning performance and reliability. In the Midwest, we firmly believe in the adage, "If it ain't broke, don't fix it." And these award-winning, price/performance systems definitely did not need fixing.

FASTER HARD DRIVES

Gateway's product development team is constantly searching the market for the highest performance, most reliable components. When we found a very reliable line of IDE (Integrated Drive Electronics) hard drives, the switch from ESDI drives was obvious. All models of the IDE drive include a built-in cache, making this one of the fastest drives on the market (as fast as 15ms access time, 10 Mb/second DTR).

TUNED MOTHERBOARDS

HOTTER VIDEO

Because our 386 and 486 computers already include the fastest, most reliable video card on the market, the only way we could improve video performance was to increase the size of video RAM. So we did. All Gateway 2000 386 and 486 systems come standard with 1 MB video RAM.

486 TECHNOLOGY AT 386 PRICES

When our 25 MHz 486 dropped below $4,000, it was the hottest value going in high-end technology. Now Gateway's new 33 MHz 486 – fully loaded – is priced at $3,995! You'd be hard pressed to find a loaded 386 for this price anywhere else. With either 486 system, you get Intel's 486 processor with built-in math co-processor and 8K cache.

EXPANDED SERVICE HOURS

We've also expanded our telephone technical support hours to accomodate

RE-AND-ICE POWER SYSTEMS

MORE FOR YOUR MONEY

With Gateway's new 386 and 486 computers, you get a terrific-looking machine. You get added performance and reliability. You get Gateway's excellent service and support with expanded hours. And you get it all for less money than ever before. That's value. That's the Gateway 2000 difference.

8 0 0 5 2 3 2 0 0 0

INTRODUCING THE AWESOME ANY

In redesigning our new product line, we paid special attention to the things you use most: the keyboard and monitor. When you work with a personal computer for hours every day, you need a keyboard that feels good and makes your input tasks as easy as possible. And you need a monitor that's comfortable to look at. Our new AnyKey keyboard and Crystal Scan 1024NI monitor will give you exactly what you need.

THE PROGRAMMABLE ANYKEY

We call it the AnyKey because any key can be programmed to perform any function – anything you can imagine, quickly and easily. It's a revolutionary new concept designed to let you talk to your personal computer in a very personal way. Boilerplate information of all kinds can be easily assigned to any key and typed into any document with a single keystroke. Or you can remap the keys to create your own keyboard layout.

EXTRA KEYS, EXTRA VERSATILITY

The AnyKey includes a numeric pad and a separate, full-function cursor pad with diagonal keys, plus two sets of function keys located along the top and left side. Other features include an unshifted asterisk, two backslash keys, an adjustable repeat rate and a software tutorial.

EASY TO LEARN

The Anykey's versatility is rivaled only by its simplicity. You can learn to program it in just a few minutes. If you goof, you can easily reset the keyboard to a normal configuration. And if you hate the idea of programming anything, you'll still love the feel and extra keys on the AnyKey. Use it just the way it comes out of the box. The AnyKey keyboard is an option with all Gateway 2000 computer systems.

Peripherals, including the AnyKey and Crystal Scan 1024NI, are sold only with Gateway 2000 systems. Sorry – we cannot sell peripherals separately.

IKEY™ & CRYSTAL SCAN 1024NI

NON-INTERLACED MONITORS – STANDARD WITH 386 & 486 SYSTEMS

From most manufacturers, a 1024 x 768 VGA color monitor is an expensive option. From Gateway 2000, 1024 x 768 color monitors have been standard for a long time. And now, the Crystal Scan 1024NI, a non-interlaced 1024 x 768 color monitor, is standard with all 386 and 486 systems.

Non-interlaced means all pixels are refreshed with each clock cycle – as opposed to interlaced monitors that take two clock cycles to refresh the entire screen image – for a solid, flicker-free video display.

LOOKING AHEAD

The introduction of our new product line represents almost a year of design and engineering. But it's just one phase in a process of continuous improvement that we employ at Gateway. Each day, Gateway 2000 employees come to work with one primary goal in mind: to provide you with better prices, performance, quality and service. We're committed to making Gateway 2000 the only logical choice in microcomputers.

We'd like to thank our customers for their valuable contributions to the redesign of our product line. It was our customers' suggestions and comments that gave us our direction. And to all the Gateway folks who began to think the 18-hour work day was normal, here's a public pat-on-the-back. Thanks for your continuing dedication.

8 0 0 5 2 3 2 0 0 0

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- 1 PS/2 Mouse Port
- 101 Key Keyboard
- MS DOS™ 3.3 or 4.01

$1395

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- 2 MB RAM
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- 1.44 MB 3.5" Drive
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- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 101 Key Keyboard
- Microsoft™ Mouse
- MS DOS 3.3 or 4.01
- MS Windows™ 3.0

$1595

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- Intel 80386SX Processor
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- 1.2 MB 5.25" Drive
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- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 101 Key Keyboard
- Microsoft Mouse
- MS DOS 3.3 or 4.01
- MS Windows 3.0

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25MHZ 386 VGA

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- 4 MB RAM
- 1.2 MB 5.25" Drive
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- 16-Bit VGA with 1 MB
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- 16-Bit VGA with 1 MB
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- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- Microsoft Mouse
- MS DOS 3.3 or 4.01
- MS Windows 3.0

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- Intel 80486 Processor with Co-Pro and 8K Internal Cache
- 64K Cache RAM
- 8 MB RAM, Expands to 64 MB
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- 1.44 MB 3.5" Drive
- 200 MB 17ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
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- MS DOS 3.3 or 4.01
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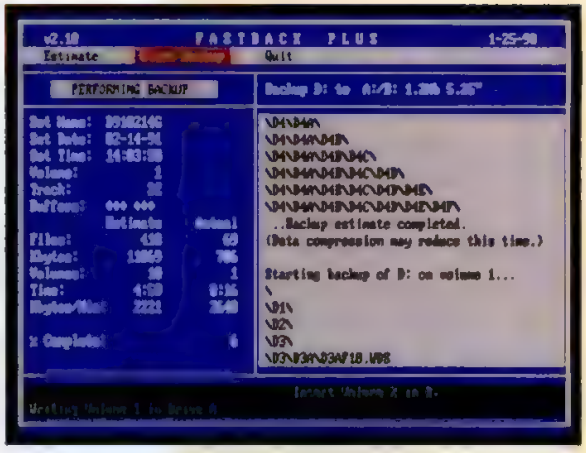
managing backup strategy. In addition, tape drive support and higher speed are promised in a later version intended for general release. Meanwhile, despite the program's weaknesses, *DMS/IB* incorporates the most intelligent backup system available for backing up to floppy disks.

Fastback Plus

by Edward Mendelson

If you prefer not to worry about your backups, get a copy of *Fastback Plus*, Version 2.1. Fifth Generation Systems' $189 package is the industry standard. Although one or two newer programs have more-extensive features and slightly greater speed, *Fastback Plus* has been used widely enough and long enough for any minor quirks or bugs to be discovered and eliminated. Version 3.0, which Fifth Generation Systems plans to have shipped by mid-April, adds some dramatic advances including greater speed and security, data management features, a point-and-click interface, custom macros, and cross-platform compatibility. Although the new version was not shipped in time for this evaluation, the company knows it has a classic on its hands.

Fastback Plus will back up to any DOS device, including network servers and the Bernoulli Box. It lets you perform backup procedures with almost any degree of complexity, although the most complex procedures will need more complex planning. Each individual backup and restore is limited to a single drive letter (some newer programs and *Fastback Plus*, Version 3, can back up multiple partitions with one command), but you can record keystroke macros that process different drives in succession or automatically back up (for example) one set of files to floppy disks on the local drive and then another set of files to the hard disk on a network server.



The backup estimates offered by *Fastback Plus* tend to be slightly pessimistic: The program usually finishes the job in less time and with fewer disks than it estimates. The display is elaborate but clear, with the bottom panel reserved for prompts.

MACRO CONVENIENCES

When setting up backup procedures for an office, you can write macros that pop up instructions and prompts so that less experienced users can select options on the fly. Passwords let you protect backup disks from unskilled or unauthorized use.

When you install *Fastback Plus*, it uses one of its macros to test your system with a sample backup and restore. When you then start the program for the first time it displays the simplest of its three levels of user interface, but you can increase the available menu options and add function-key shortcuts by switching to more-advanced levels. The most advanced options let you customize fine details, such as mouse sensitivity and the sound of error beeps.

In addition to ordinary full or incremental backups, *Fastback Plus* allows "differential" backups of every file modified or added since the last full backup. You can choose files or directories for selective backups by tagging them on a tree display or typing in file specs, but you can only select up to 20 individual file specs or directory branches (for example, a directory and all its subdirectories). A macro that loads a sequence of backup setups can get around this limit. Each new backup set begins on a new disk; you can't start a backup on the space remaining on the last disk you used for a previous backup.

You can use the program to transfer files to another computer by making a backup without resetting the archive bits for the selected files; as a result these files will be included in the next incremental backup, even though you've already used *Fastback Plus* to copy them. You can also transfer files from a Macintosh to a PC by backing them up with Fifth Generation's *Fastback II*, converting the backups to DOS format on a Macintosh Superdrive or 5.25-inch floppy disk drive, and then restoring them to the PC using *Fastback Plus*.

Restoring a full disk is simple: If the backup log isn't on your hard disk, the program reads it from the last disk of the backup set or, if the log is damaged or lost, reconstructs it by reading each disk in turn. If you want to restore only one or two files, run the Estimate Restore option first, and then let the program prompt you for the right floppy disks. This procedure, barely mentioned in the manual, saves you from scanning all the floppy disks in a backup set.

GAINING SPEED

No longer the reigning speed champion, *Fastback Plus* still has nothing to be ashamed of when it comes to its performance. When backing up to unformatted floppy disks, it transferred PC Magazine Labs' 11MB set of files in 6 minutes 58 seconds; part of that speed is the result of data compression that successfully squeezed the files onto five 1.2MB floppy disks. Only *The Norton Backup* and *Central Point Backup* performed the job faster. The program posted identical timings (and

***Fastback Plus*, Version 2.1**
Fifth Generation Systems Inc., 10049 N. Reiger Rd., Baton Rouge, LA 70809; 800-873-4384, 504-291-7221.
List Price: $189.
Requires: 335K RAM, DOS 2.1 or later.
In Short: Still among the fastest backup programs, *Fastback Plus* remains the industry standard, with a long history of safety and reliability. Although it's not designed for simple backups of multiple partitions or long lists of individual file specs, it is highly flexible for standard backup tasks.

CIRCLE 542 ON READER SERVICE CARD

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CIRCLE 116 ON READER SERVICE CARD

> Fifth Generation uses a few special tricks to let the program write more quickly during a subsequent backup.

used the same number of floppy disks) with its compression options set to Save Time and to Save Disks, but Fifth Generation (like many other vendors) says that this is a typical occurrence on fast machines such as PC Labs' 25-MHz test system, and that slower machines show different results with these two options.

Using floppy disks already formatted by *Fastback Plus* on the fly during an earlier backup, the program backed up all files in 3 minutes 26 seconds—slightly faster than *Central Point Backup* on a similar test, but still slower than *Norton*. (Restoring the test files took exactly the same time.) *Fastback Plus* creates backup floppy disks that are formatted to be readable by DOS, but Fifth Generation says its formatting uses a few special tricks that let the program write to the disk more quickly during a subsequent backup than it can when writing to ordinary DOS-formatted floppy disks. On our 25-MHz test system, PC Labs found no measurable speed difference when backing up to *Fastback*-formatted and DOS-formatted disks, but such differences would be magnified by slower machines.

Not surprisingly, *Fastback Plus* handled all error conditions with aplomb. It rejects bad or wrong-capacity disks during backups, makes attempts to recover data from damaged disks during restores, and explicitly prompts you on each of its actions.

When *Fastback Plus*, Version 3.0, makes its appearance, it will provide faster backups and restores, a mouse-compatible interface with resizable windows, an express menu for no-fuss backups, a macro language and scheduler that will let you write nested macros and run unattended backups, full support for Novell's *NetWare 286* and *386*, a *dBASE*-format history log so you can automatically restore the latest version of a file, and advanced password protection. (Current *Fastback* users can upgrade for $45.) You can also expect to see *Microsoft Windows* and network versions as Fifth Generation positions *Fastback Plus* not just as a backup utility, but as an essential tool for secure, well-managed data.

BACKUP SOFTWARE: SUMMARY OF FEATURES

Products listed in ascending price order

	Diskpack	BakupWiz	Central Point Backup	PC-Fullbak Plus	SitBack	TakeTwo Manager
List price	$49	$59	$99	$99	$99	$139
TYPE OF BACKUPS PERFORMED						
Directory	■	■	■	■	■	■
File-by-file	■	■	■	■	■	■
Files after specified date	■	■	■	■	❑	■
Files after specified number of days	❑	❑	❑	❑	■	■
Files with archive bit set	■	■	■	■	■	■
Files within date range	❑	❑	■	■	❑	❑
Hidden files	■	■	■	■	■	■
Read-only files	■	■	■	■	■	■
System files	■	❑	■	■	■	❑
Wildcard or filename	■	■	■	■	■	■
RESTORE FEATURES						
Prompts before overwriting files	■	■	■	■	■	■
Restores backups with XCOPY.EXE	❑	❑	❑	❑	■	■
Restores to different directory	❑	■	■	■	■	■
Restores to different drive	■	■	■	■	■	■
Searches catalog for filename	❑	■	■	■	■	■
Uses wildcards in file spec	❑	■	■	■	■	■
ADDITIONAL FEATURES						
Estimates number of floppy disks needed*	❑	❑	■	■	❑	■
Formats floppy disks as needed	❑	■	■	■	❑	■
Has adjustable video modes	❑	■	❑	❑	■	❑
Has verify option	■	■	■	■	■	■
Provides on-line help	■	❑	■	■	■	■
Resumes interrupted backup	❑	❑	❑	■	■	■
Runs from batch file	■	■	■	■	■	■
Saves user configurations	❑	❑	■	■	■	■
Saves multiple configurations	❑	❑	■	❑	■	❑
Schedules automatic backups	❑	■	■	❑	■	■
Stores macros	❑	❑	❑	❑	■	❑
Uses data compression	❑	❑	■	■	❑	❑

PC—Editors' Choice ■—Yes ❑—No

*All packages support 360K, 720K, 1.2MB, and 1.44MB floppy disk drives.

The Norton Backup

by Edward Mendelson

The Norton Backup is one of the rare programs that gets virtually everything right. Symantec's $149 package, one of the newest backup utilities, backs up and restores files at unprecedented speed and has more safeguards and customization options than any other backup program that is currently available. Unless you need tape drive support (which is scheduled to be built into the next version), *Norton* probably has everything you need right now, in a package that's elegant, reliable, and fast.

If you need to establish a backup strategy in a corporate setting, *The Norton Backup* provides an almost ideal set of unique features. In addition to options that let you set the program to display beginner-level or advanced-level menus, you can also set the menus at a "preset" level, which allows the user to run only backups and restores that you have planned and specified in advance. These preset levels correspond to the storable setups offered by other programs; their advantage is that with the preset-level menu option turned on, the user has to choose among them, and can't modify them without reconfiguring the program. You can control the process further by specifying that the program perform a full backup when run after a set number of days, even if you select an incremental backup provided from the menu of preset choices.

MULTIPLE PARTITION HANDLING

Unlike most other backup programs, *Norton* makes it easy to process files from multiple partitions during a single backup and restore. You simply select files or directories from a directory tree, or type file specifications on a menu equipped with ingenious shortcuts for duplicating or modifying entries. Any file selection, no matter how complex, can be stored in the default setup or any other preset configuration.

The program's menus look like *Microsoft Windows* dialog boxes so that you can navigate easily with a mouse or shortcut keys. You don't even need to use the menus if you want to restore a single file or file spec. You merely enter on the DOS command line:

```
NBACKUP /R filespec
```

The program finds the file you want in its log and prompts you to insert the right floppy disk for restoring it. You can even specify an earlier backup log on the command line if you want to restore an earlier version of the file than the one stored in the most recent backup.

BLAZING SPEED

Norton blazed through PC Magazine Labs' speed tests, backing up 11MB to unformatted floppy disks in 5 minutes 54 seconds. A restore took 2 minutes 24 seconds. When we backed up to disks already formatted in the program's optional proprietary format, the same backup required only 2 minutes 50 seconds. On all three tests *Norton* registered markedly better scores than any other program, and with the compression option set to save disks

DMS/IB Intelligent Backup	The Norton Backup	Back-It 4	Fastback Plus	Sytos Plus File Backup Manager
$149	$149	$169	$189	$225
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
❑	❑	❑	❑	❑
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
❑	❑	❑	❑	❑
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	■
■	■	■	■	❑
■	■	■	■	■
■	■	❑	■	❑
■	■	■	■	■
■	■	■	■	■
❑	❑	❑	❑	❑
■	■	■	■	■
■	■	■	■	■
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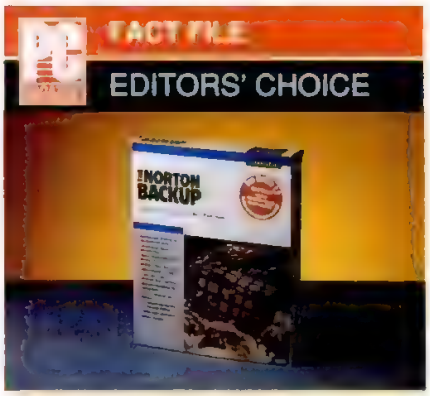
■	❑	■	❑	■
❑	■	■	■	■
■	■	■	■	■



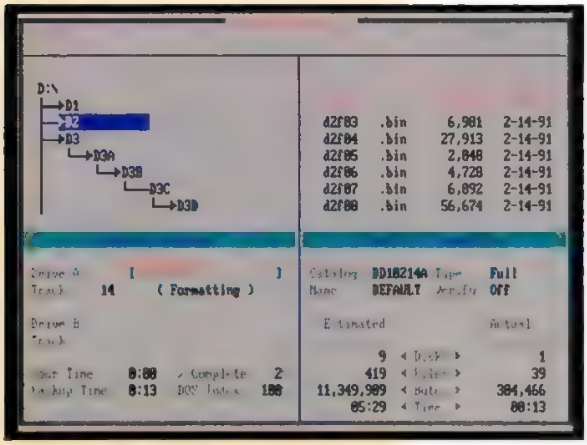
***The Norton Backup*, Version 1.2**
Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-253-3750.
List Price: $149.
Requires: 512K RAM, DOS 3.1 or later.
In Short: *Norton* is the fastest, most convenient, and most flexible backup program on the market, with special features for corporate use. Tape support in the forthcoming Version 2.0 will add to the extraordinary range of features in this product.

CIRCLE 843 ON READER SERVICE CARD

rather than time, the backup was only a few seconds slower. Both settings of the compression option needed a mere five 1.2MB disks.

Norton performs at its fastest when you select the option to use its proprietary floppy disk format. The resulting floppy disk is an ingenious hybrid: you can't copy a file from it using DOS, but if you run DOS's DIR command on it, you'll receive a message that the disk uses *Norton*'s format. This unique feature can save you from reformatting the disk by mistake, as you can all too readily do with other programs' proprietary formats.

Any device with a drive letter can provide storage for *Norton*'s backups. After you complete a full backup, you can follow it with incremental backups that copy only files modified, since the last backup.



***The Norton Backup* reports its progress with a clear display, using colors and check marks to indicate processed files. Progress through each backup disk is also indicated with a clear graphic.**

You can also use the program for transferring files without modifying the archive bit. An "administrative guide" pamphlet that supplements the skimpy and disorganized manual clarifies these options and other points that should have been explained in the manual itself.

Norton sails gracefully past the rocks of any error condition PC Labs can imagine, including defective and wrong-capacity floppy disks. Even when we deliberately gouged a floppy disk containing a backup, damage that would never occur in normal use, the program never faltered; it did indicate the damaged files, asked if we wanted to recover them anyway, and reported the results of its attempts.

With unparalleled speed, convenience, flexibility, and safety, *The Norton Backup* stands alone as the premiere backup software for private or corporate use. When tape support and a well-organized manual arrive with Version 2.0, *Norton* may become the undisputed industry standard.

PC-Fullbak Plus

by Greg Pastrick

PC-Fullbak Plus, Version 2.02, from Westlake Data Corp. takes a streamlined approach to data backup. A simplified version of *PC-FullbakEZ*, this $99 package allows you to set all options and configurations from a single screen and is ideal for inexperienced users who need fast, basic backups.

With this release, Westlake Data Corp. introduces backup support to any logical device including the Bernoulli 44MB disk drive and the Colorado Memory and Archive Memory DC-2000s. There's also tape support for the Archive and Wang/Everex DC-600s as well as the ST-60 cassette. Other new features include improved error correction and expanded context-sensitive help. Though the package doesn't compete with the best backup packages when it comes to speed, it does achieve efficient data compression in both its DOS and proprietary formatting of media.

OPTIMAL SETTINGS

From a top-line menu selection list on the main screen, you enter *PC-Fullbak*'s multilayered menus and access the program's well-designed and readable screens. The Options menu configures the system for all operations including complete settings for backup, compare, restore, lists, devices, and video. The screen displays detailed settings through which you can scroll and make selections.

For example, from *PC-Fullbak*'s Options menu, you set the source and target drives, choose to backup new files or updated files, append files to a previous backup, and select compression method. While most options have yes/no answers, the compression method option offers three choices: SaveMedia, SaveTime, or None. For optimal backup speed, you turn off the options for compression, error correction, writing a log file, and verification of data from this screen. Alternatively, for optimal compression, you select SaveMedia.

Another notable feature, the Restore menu's Point and Shoot, restores specific files from the backup log and the specification of drive capacities, format choices, logical devices, and tape drives from the device options menu.

Though not unique among the packages reviewed here, one of the more useful features of *PC-Fullbak Plus* is its appended backup. While the package allows full and incremental backups and creates multiple destination and log files in the process, the append feature adds files to an existing backup, with no restriction on the backup type assigned to an appended backup.

ERROR-TRAPPING TECHNIQUES

PC-Fullbak's emphasis on backup data integrity sets it apart from the pack. As an adjunct to its Verify option, the program has a separate Compare function to analyze and confirm that no errors or damaged files have been introduced during the backup process. It's a safety net and useful troubleshooting technique that ensures solid restoration of files, assum-

***PC-Fullbak Plus*, Version 2.02**
Westlake Data Corp., P.O. Box 1711, Austin, TX 78767; 512-328-1041.
List Price: $99.
Requires: 512K RAM, DOS 2.0 or later
In Short: *PC-Fullbak Plus* offers an easily managed, direct approach to backups and restores, with good data compression and functions that emphasize the maintenance of data integrity. Though the price is appealing, its backup performance speed is not.

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CIRCLE 731 ON READER SERVICE CARD

ing the source can be backed up again once a comparison turns up errors.

On our pass/fail benchmark test, *PC-Fullbak Plus* exhibited its error-trapping capability by effectively recognizing and dealing with media that was damaged, introduced out of sequence, or of the wrong capacity. The program failed only once, when we interrupted the backup process by opening the drive door.

The timed tests showed the program's efficient compression and restore functions, but along with *BakupWiz* and *DMS/IB Intelligent Backup*, it was one of the slowest to complete the backup tests. You'll get the best speed and compression results with *PC-Fullbak Plus*'s proprietary format rather than the DOS format.

The first copy of *PC-Fullbak* we received was unable to perform a backup under the proprietary format to the 1.2MB floppy disk drives on our test machine. So we did the initial testing under the DOS format while Westlake investigated the apparent bug. It discovered that, in the course of updating and testing the code for new tape drive support, error-checking routines for disk formats were commented out. This simple error prevented the 5.25-inch floppy disk from being formatted in the proprietary mode. Westlake delivered

BACKUP DOs AND DON'Ts

by Edward Mendelson

DO plan a backup strategy and stick to it. If you accumulate backup disks haphazardly, you'll waste floppy disks, tapes, and hours trying to find the file you need.

DON'T use foreign or graphics characters in your filenames unless you're certain your backup software will process nonstandard filenames. Some programs treat nonstandard filenames as if they were corrupted and won't back them up.

DO keep at least one full backup set in deep storage for six months to a year, even if you recycle the floppy disks and tapes in your other backup sets. The file you most want to recover may turn out to be one that you deleted three months ago, and your recent backups won't have any trace of it.

DON'T keep all your backups in one place, and don't leave them all in the drawer under your computer. A thief might decide to help himself to some disks when he walks off with your machine.

DON'T use data compression when backing up files that have already been compressed with software like PKZIP or ARC. You'll only lose time by forcing the compression routine in the backup software to make a futile attempt at compressing the file further.

DO turn on the error correction and verification options in your backup program. Most of today's advanced programs use error correction to duplicate data in more than one part of a disk, and can successfully recover files from damaged or magnetically weakened floppy disks.

DO use 3.5-inch floppy disks instead of 5.25-inch floppy disks for backups if your machine uses both sizes. The smaller disks are sturdier and less damage-prone.

DON'T try to economize by using generic floppy disks for backups or by trying to format 720K disks to a 1.44MB capacity. The money you save is worth less than the data you'll lose.

DO set your backup program to preserve detailed logs of every backup. The program will need them when you want to recover a specific, older version of a lost or modified file.

DO use your backup program as a fast and cheap way of transferring files between two computers; many programs allow you to perform backups without switching off the archive bit. This option lets you use the backup program's speed and compression to pack many files on a few disks—without preventing them from being backed up in your next incremental backup.

DON'T trust your backup program until you test it in real-world conditions. Perform a small backup with all your usual memory-resident software installed. Restore the files to a different directory and run DOS's COMPARE command on the original and the restored set. If they match, you can sleep easily.

DO retest your backup software after installing any new memory-resident software. It's probably impractical to run backups only from a clean DOS, but if you run into any difficulty with TSRs, it may be the only safe course of action.

DO perform your backup software's hardware compatibility test after installing any new expansion board or hard disk in your system. Most advanced packages support high-speed DMA transfers that can be subtly affected by newly added equipment.

DO consider purchasing a tape drive if you have more than 30MB of data on your hard disk. Large floppy-disk backups can be so tedious that you'll avoid them at all costs. A good tape drive can back up your entire disk while you're having lunch.

DO run CHKDSK before backing up. If any files have been corrupted, you may be able to use a disk utility to recover at least some of your data, and you may be able to recover more from the set of old backup disks that you're about to overwrite.

DO make at least two fresh backups (and test one) before reformatting or replacing your hard disk.

DO use password protection or encryption when backing up critical data if your program provides that feature. If not, lock up your backups in a secure place.

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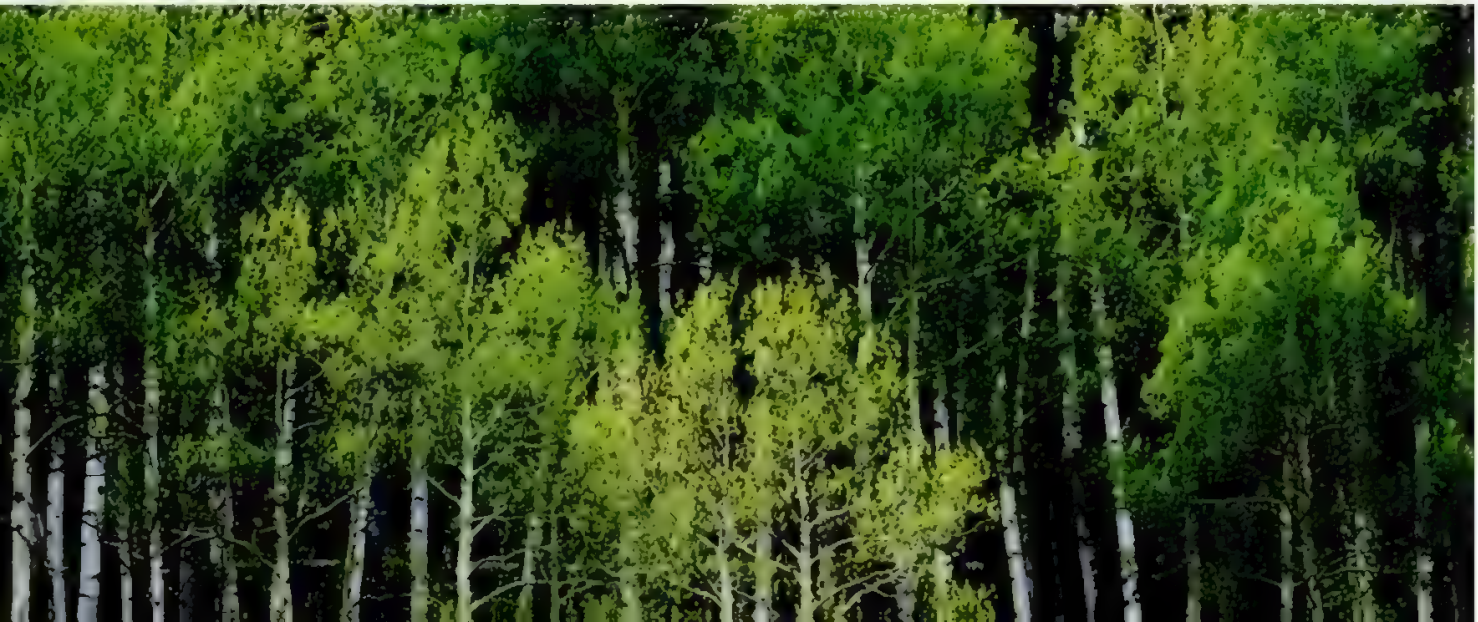

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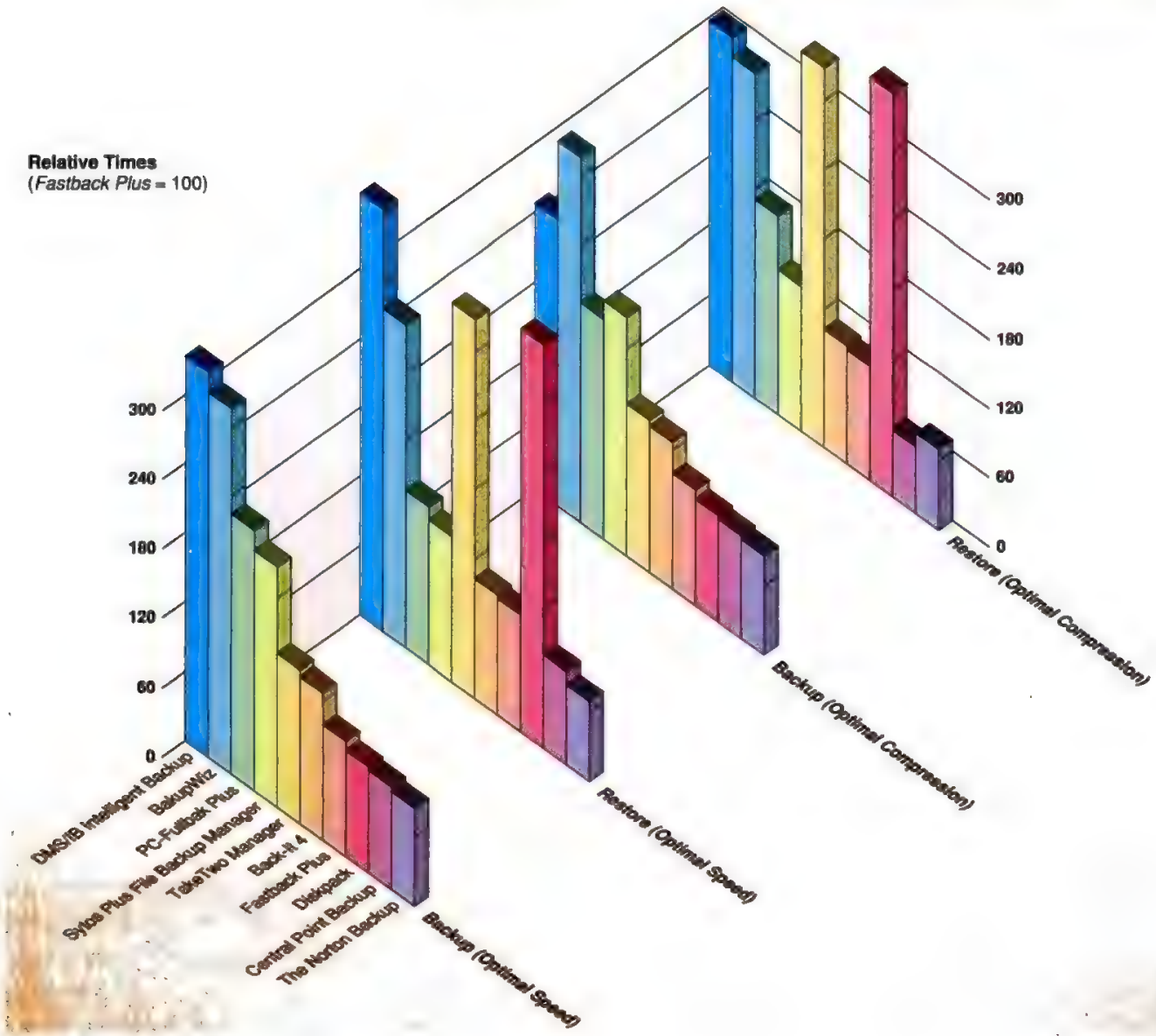
PERFORMANCE TESTS: BACKUP SOFTWARE

The Norton Backup is the surprise speed king in backup software performance testing, but former leader _Fastback Plus_ is not far behind. _SitBack_, the TSR backup program, was not tested.

TESTING ANALYSIS

The Norton Backup outperformed all of the other contenders on the Backup tests, both in speed and in data compression. It took *Norton* only 5 minutes and 54 seconds to back up 12.3MB to five floppy disks; that's a throughput of about 2.09MB per minute at 2.5MB per floppy disk. *Central Point Backup* was a close second and equally impressive, beating *Norton* by 24 seconds on the Restore (Optimal Compression) test. Data compression made the difference between them, since *Central Point Backup* needed six floppy disks, and time was obviously lost in formatting the additional disk. *Fastback Plus* was the only other product that could back up the data onto five floppy disks.

On the Restore tests, throughput was much faster, since formatting floppy disks was not a factor. *Central Point Backup* clocked the fastest time, at 2 minutes, with a throughput of about 6.15MB per minute. *Norton*'s throughput was 5.16MB per minute. The big surprise was *Diskpack*. It did extremely well on the Backup tests, edging *Fastback Plus* out of third place by 33 seconds and falling behind *Central Point Backup* by 11 seconds. When it came to restoring, however, *Diskpack* took almost 12 minutes, placing it dead last on the Restore (Optimal Compression) and next to last on the Restore (Optimal Speed) tests. *Diskpack*, along with *BakupWiz*, *Sytos Plus File Backup Manager*, *TakeTwo Manager*,



and *Back-It 4*, does not have separate settings for optimal speed and optimal compression. For those products, we published the same times on both sets of tests.

Note that the Backup (Optimal Compression) times for both *DMS/IB Intelligent Backup* and *PC-Fullbak Plus* are faster than their Backup (Optimal Speed) times. Before running the benchmark tests, we asked the vendors to supply us with settings for optimal speed and optimal data compression. It may be that the vendors failed to note that we were testing on a 25-MHz 386-based machine and gave us optimal settings for a less powerful 8088- or 286-based system, where additional processing time to compress data is required.

HOW WE TESTED

We tested the backup packages on 25-MHz 386-based Compaq Deskpro 386/25Es with 300MB hard disks, two 1.2MB floppy disk drives, and 4MB of extended RAM. The hard disks were configured under Compaq's version of MS-DOS 4.01 and segmented into two 150MB partitions. CONFIG.SYS and AUTOEXEC.BAT file settings were supplied by the backup software vendors, and SHARE.EXE was loaded.

We installed the backup software on one machine's C: drive and placed the data to be backed up on its D: drive. There were 418 test files totaling 12.3MB. Test data comprised a representative mix of binary and ASCII files distributed through 15 subdirectories, and the longest subdirectory name was six levels deep. About 70 percent of the test data was made up of sequential and random ASCII files, and the rest of the data was binary. We included one sequential 2MB ASCII file to ensure that at least one file would span two floppy disks. The test data also included zero-byte files, hidden files, system files, and empty subdirectories.

We used two test machines for the Backup and Restore tests. We backed up the D: drive from the first PC onto unformatted 1.2MB disks and then restored the data to the D: partition on the second machine. The D: drive on the second machine was reformatted after each test. Whenever possible, we used an alternate floppy disk drive setting—inserting one floppy disk in the A: drive and the next floppy disk in the B: drive, alternating drives until the test was completed. If the product did not support alternate drive backups, we stopped the timer while changing disks.

In addition to the benchmark tests, we conducted various error recovery tests to determine how well the program handled problems or unusual situations. In one test, we opened the floppy disk drive door during a backup. In others, we used damaged floppy disks or mixed floppy disks of different densities. The results of these tests are discussed in the reviews.

■ The **Backup (Optimal Speed)** test measures how quickly the package can back up 12.3MB of data when configured with the optimal speed settings recommended by the manufacturer. The program must format 1.2MB floppy disks before backing up files. Optimal speed backups often do not perform any data validation or error checking.

■ The **Restore (Optimal Speed)** test measures the time it takes to restore 12.3MB of data to a hard disk. Restored data was backed up on 1.2MB floppy disks using the optimal speed settings recommended by the vendor. The hard disk was formatted prior to the test.

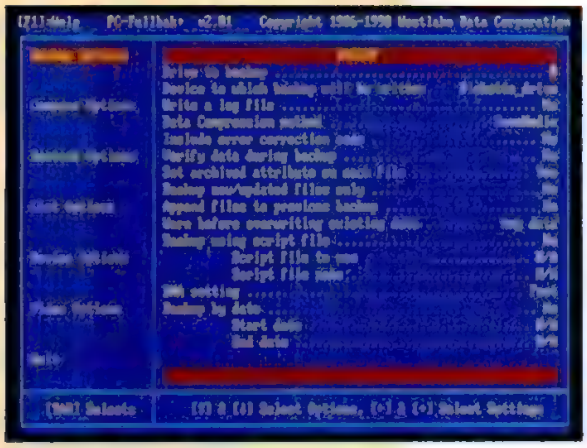
The **Number of Disks Required (Optimal Speed)** indicates the number of 5.25-inch 1.2MB floppy disks required to complete the test.

The **Backup (Optimal Compression)** test measures how long it takes to back up 12.3MB of data when the software is configured for maximum data compression. Optimal compression is the setting that uses the smallest number of backup floppy disks. The program must format 1.2MB floppy disks before backing up files. *BakupWiz, Sytos Plus File Backup Manager, TakeTwo Manager, Back-It 4,* and *Diskpack* compress data, but the degree of compression is not adjustable.

The **Restore (Optimal Compression)** test measures the time it takes to restore 12.3MB of data to a hard disk. Restored data was backed up on 1.2MB floppy disks using the maximum data compression settings recommended by the vendor. The hard disk was formatted prior to the test.

■ The **Number of Disks Required (Optimal Compression)** indicates the number of 5.25-inch 1.2MB floppy disks required to complete the test.

	OPTIMAL SPEED			OPTIMAL COMPRESSION		
	Backup Elapsed Time (seconds)	**Restore** Elapsed Time (seconds)	**Number of Disks Required**	**Backup** Elapsed Time (seconds)	**Restore** Elapsed Time (seconds)	**Number of Disks Required**
DMS/IB Intelligent Backup	1,396	752	11	1,035	612	7
BakupWiz	1,322	576	10	1,322	576	10
PC-Fullbak Plus	936	280	10	797	353	6
Sytos Plus File Backup Manager	865	258	6	865	258	6
TakeTwo Manager	551	675	10	551	675	10
Back-It 4	532	213	6	532	213	6
Fastback Plus	418	206	5	418	206	5
Diskpack	385	719	7	385	719	7
Central Point Backup	374	165	6	374	120	6
The Norton Backup	354	143	5	359	144	5



PC-Fullbak Plus's Options menu configures the program for all its operations. Selection of the Backup category from the vertical list on the left pops a screen of detailed settings for specific backup features.

a new program disk for testing under that mode and assured us that it will ship a replacement program disk to any user who runs into the problem.

Marred only by its slow backup speed, *PC-Fullbak Plus*'s streamlined approach to backups, sound data-compression, and useful error-checking features make it well worth its affordable price.

SitBack

by Greg Pastrick

Getting into any backup routine takes discipline. If you don't have any, then get *SitBack*, Version 3.02, a $99 memory-resident program from SitBack Technologies that's effortless when it comes to the basic backup of your most important files. Just put the letters SB in your AUTOEXEC.BAT, and your work is done. Occupying 16K of RAM, *SitBack* is on constant guard, handling full and incremental backups by copying any new or modified files at intervals you determine.

SitBack's strength is selective backups. You specify when and what to back up and the program automatically executes incremental backups for multiple file specs. You can set up one or more backup configurations that give you the flexibility to back up files with common file extensions, to back up certain drives or directories, and to back up multiple drives and files to different destinations, including hard disk partitions.

You can back up files to any device identified with a drive letter: floppy disks, hard disks, network drives, high-capacity removable media such as Iomega's Bernoulli Box, and optical drives including Harris, Panasonic, Pioneer, Ricoh, Sony, and Storage Dimensions. *SitBack* is bundled with the Bernoulli and CorelDRIVER, an optical drive interface kit with software, utilities, and a SCSI interface adapter.

We did not test *SitBack*'s performance since, as a TSR, the package is meant to be constantly active and functional in the background. Our multiple floppy disk backup tests were basically inapplicable to *SitBack*'s backup style.

BACKGROUND BACKUPS

SitBack's interface is easy to use, and configuration and setup menus are directly accessible. The main menu entries are as simple as Where and What to Back Up, What Not to Back Up, and When to Back Up, and the submenus are equally clear. Optimal settings for backup and restore speed are set under the Performance Settings main menu option. Set the buffer size to the 64K maximum, the background priority level to 1, hit F10 to save, and you're ready to work—confident that *SitBack* is quietly doing its job. The backup and restore files are DOS-readable, and errors are recorded to an ASCII error log. Outside of beep prompts for errors or as an alert to change disks, there's little to let you know that the program is active.

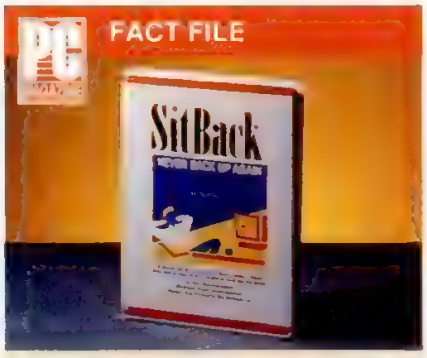
SitBack really wouldn't have much to offer as a standalone system using floppy disks. For true unattended backups, you would direct backups to a destination other than floppy disks. In the absence of large media, the most sensible strategy is to confine backup operations to highly-specified groups of files that can fit on a few disks. This is the only way to get the most freedom from *SitBack*'s background operations when you have to deal with backing up to floppy disks.

For example, in a work environment where active and critical workday file output comes from one primary application, you would leave a floppy disk in the system all day and set the backup configuration to pick up only those files during the most active times of the day. You can designate incremental backups to work at the start or end of the day when the number of new and modified files may require you to insert a new disk.

SCHEDULING INTERVALS

One of *SitBack*'s unique features is the option to use idle time to back up. From the When to Back Up screen, you designate the amount of time (in seconds) the keyboard remains inactive before *SitBack* scans for new or modified files. If you set the interval at zero seconds, this feature is disabled. In addition to performing backups during keyboard delays, *SitBack* lets you specify two automated backups per day for each day of the week. The program does not back up open files. When you need to back up before the preset times or don't want to wait for the keyboard delay, a third option requires you to type SB G at the command line.

You enter specific backup configurations in the What and Where to Back Up submenu. File inclusion and exclusion is handled primarily through this screen and the What Not to Back Up screen. *SitBack*'s TSR directory navigation utility is useful for scanning contents of subdirectories and marking individual files for backup and restore and may be invoked from any of the menus.



***SitBack*, Version 3.02**
SitBack Technologies, 9290 Bond, #104, Overland Park, KS 66214; 800-873-7482, 913-894-0808.
List Price: $99.
Requires: 16K RAM, DOS 3.0 or later.
In Short: The memory-resident *SitBack* handles full and incremental backups in multiple user-defined configurations with a minimum of interference to normal computing operations when used with any media other than floppy disk drives.

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Perfect 10.
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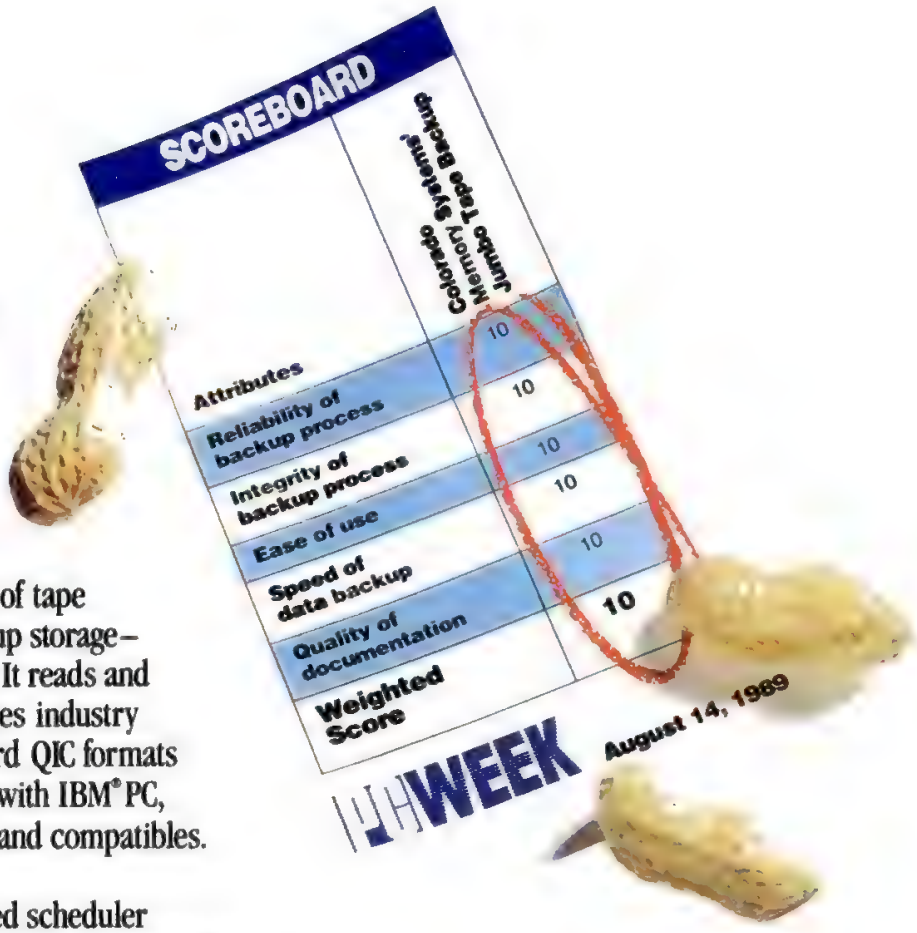

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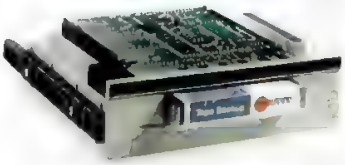

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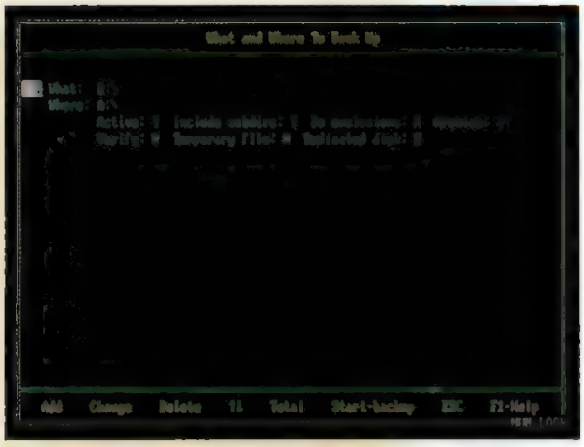
CIRCLE 473 ON READER SERVICE CARD



Set up of *SitBack*'s backup configurations are simple and direct. This configuration is set for a full backup, though more refined backups may be designed by writing the file spec to pick up only those files you want.

One of *SitBack*'s strongest features is the Archive option that records up to 100 versions of a file with a filename of six characters or less and ten versions of a file with a filename of seven characters. This is a valuable feature in any work environment that deals with multiple versions of the same files.

The program comes with a Purge utility so you can recycle backup floppy disks. There is also a backup and restore utility for large files that won't fit on one floppy disk. This utility splits a file across disks in a nonDOS format. This procedure does not run in the background and offers fewer backup and restore functions.

SitBack Technologies expects to ship a $139.95 *Microsoft Windows* version this spring. As with all TSRs, the potential for conflicts with other programs exists, but if you value simplicity over functional sophistication, then *SitBack*'s non-intrusive method of automating backup makes it a good choice.

Sytos Plus File Backup Manager

by Edward Mendelson

When you unpack a high-capacity tape drive that uses DC-600 or DAT cartridges, the software that you're most likely to find in the box is *Sytos Plus File Backup Manager*. Sytron's $225 backup program is a heavy-duty utility that doesn't dazzle you with a pretty screen, intuitive menu structure, or blazing speed. However, it can handle the most complex and customized backups and restores with automated aplomb, and partially makes up in compression what it loses in speed.

If you use the huge files for which *Sytos Plus* is designed, there's a good chance you may be using OS/2 and *LAN Manager*. Sytron has an OS/2 version and works with the same tape drives as the DOS version, and a *Microsoft Windows* version is on the way. All three versions use a consistent interface, and the DOS version even uses an optional quasi-graphics interface that loads special screen fonts to create *Windows*-style check boxes and radio buttons.

For its basic operations, *Sytos Plus* uses CUA-compliant drop-down menus, but as soon as you delve deeper into the program, its interface gets more confusing. For example, if you open any low-level menu, the main menu bar remains visible on the top line of the screen even though it's now completely inaccessible.

The essential element of a *Sytos Plus* backup is a "Procedure" that corresponds to the setups and configurations in other programs. You Load or Save or Preview a procedure from the main drop-down menu, and define or modify them in lower-level *Windows*-style menus that you navigate with function keys or a mouse. If you prefer to keep your hands on the keyboard, you'll have to get used to pressing F2 to get to the next stage of most procedures when you would normally use Enter. A quick start guide walks you through the most important keystrokes.

COMPLEX CUSTOMIZING

The sample procedures that come with the package can be customized to suit virtually any backup or file-management needs. You can automatically follow each backup with a compare and automatically delete files from your hard disk after backing them up. You can select any number of partitions, directories, or files by tagging them from a directory tree or entering file specifications.

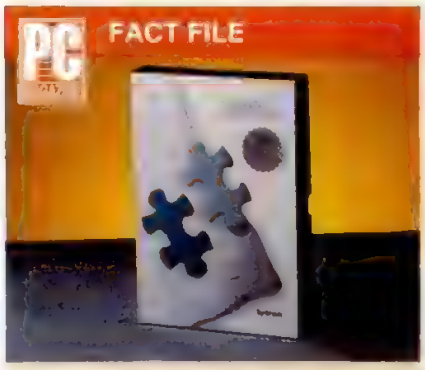
Virtually all backup programs let you limit file selection to a specified range of dates. *Sytos Plus* is unique in letting you use different date ranges for individual directories and file specs. If you want to back up all .WK1 files created in January and all .DBF files created in February, or recent files in one directory and older files in another, *Sytos Plus* makes the job effortless.

A 2K memory-resident scheduler lets you run procedures at specific days and times, at intervals of a specified number of hours, or at daily, weekly, or monthly intervals. Under DOS, your system must be at the DOS command line for the scheduler to switch on the program.

ROBUST NETWORK FEATURES

Sytos Plus's record-keeping is robust enough to let you keep track of even the largest network backups. You can customize logs to include or omit filenames, and the list of logs identifies individual operations by useful descriptive names. In addition, you can attach a long free-form description to any procedure or individual backup.

Other network options let you tell *Sytos Plus* to return to open files after a set interval or at a specified time. Under *NetWare* the program can automatically alert the user of the open file and ask that it be closed. One possible limitation in networks and single-user environments is the absence of any support for



***Sytos Plus File Backup Manager*, Version 1.21**
Sytron Corp., 117 Flanders Rd., P.O. Box 5025, Westboro, MA 01581; 508-898-0100.
List Price: $225.
Requires: 640K RAM, DOS 3.0 or later.
In Short: Despite an awkward interface, *Sytos Plus* is the industry standard for networks that use high-capacity drives and for anyone whose backups require highly complex file selection filters. Floppy disk support, which is mostly an afterthought, is slower than in most other advanced programs.

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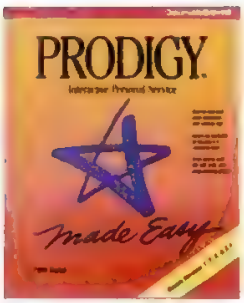

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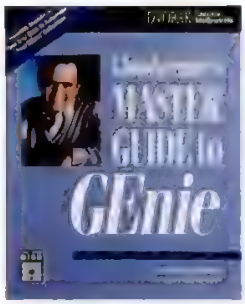

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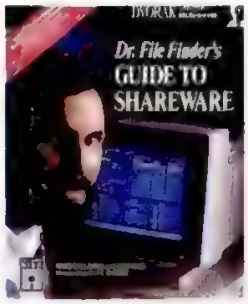

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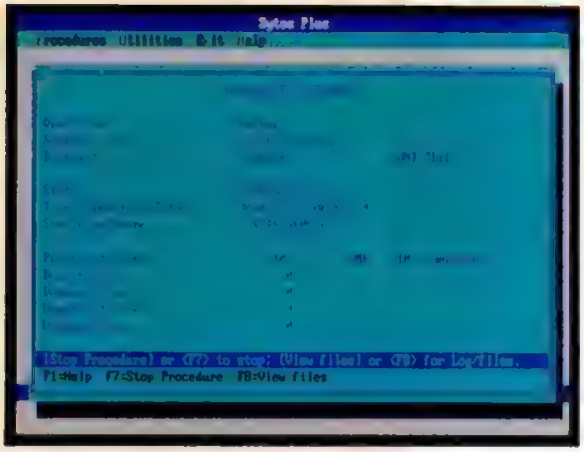

Sytos Plus **displays its progress on a business-like screen. Although the top-line menu is displayed, you can't access it. You can only choose the keys listed at the foot of the screen, or mouse-click on the functions named on the bottom line.**

backups to standard DOS devices like hard disks or the Bernoulli Box; *Sytos Plus* uses special drivers for all its device support, and these drivers are currently limited to tape drives and floppy disk drives.

Because *Sytos Plus* was designed mostly for tape drives, its performance with floppy disks may not be the best measure of its backup capabilities. It took a leisurely 14 minutes 25 seconds to back up 11MB of data, but its data compression squeezed the data onto six 1.2MB floppy disks. After announcing that all files were backed up, the program took about another 90 seconds (included in PC Magazine Labs' timing score) before it returned control of the keyboard to the user. Restoring the data took 4 minutes 18 seconds.

The backup progress screen is less informative than it could be: While formatting disks, the timer doesn't increment, and the machine appears to be locked up. If you make a selective backup instead of backing up every file, at the end of a restore you will see a disturbing prompt that indicates not all files were processed—even though the program restored every file you backed up. This prompt occurs because the program records the entire directory structure of your hard disk during the backup process and recognizes that it did not restore every file on the source system.

The package's error handling is generally adequate but not quite perfect. When we deliberately damaged a disk from a backup set and then tried to use it for a restore, *Sytos Plus* first prompted that the disk was defective and then locked up.

Unless your file-selection requirements are especially complex and arcane, *Sytos Plus* won't be your first choice for backing up to floppy disks. In a crowded network environment where enormous files call for high-capacity tape drives, *Sytos Plus* is not only an excellent choice—it's your only choice.

TakeTwo Manager

by Greg Pastrick

TakeTwo Manager, Version 2.01b, is a total file management and backup package with an abundance of useful features, functions, and intelligence. Yet, for all this overachievement, this $139 package from United Software Security overlooks some of the basics and is missing two key job requirements: speed and compression.

The package offers versatile multiple partition backups and restores, menu-driven and command-line functions, hard disk and file management functions, automatic and unattended backups, multiple system and file configurations, and report generation. It also includes server, tape drive, and alternate device support.

***TakeTwo Manager*, Version 2.01b**
United Software Security Inc., 8133 Leesburg Pike, #380, Vienna, VA 22182; 703-556-0007.
List Price: $139.
Requires: 360K RAM, DOS 2.1 or later.
In Short: *TakeTwo Manager* has an abundance of features and functions, including a full-featured disk and file management program. But its slow backup and restore performance and lack of disk-saving compression make it less attractive than some of the competition.

CIRCLE 547 ON READER SERVICE CARD

MULTIPLE MENU STRUCTURE

Don't be alarmed if you're unable to automatically install *TakeTwo* on a machine using DOS 4.01 with SHARE loaded, which is recommended when using large media. You have two options: Remove SHARE from memory and proceed with automatic installation, or manually install the software. Either way, you'll have the option of entering the *TakeTwo Manager* system configuration screen or immediately starting a default backup.

System configuration is the first of many menu, configuration, and option screens you'll have the opportunity to explore. As you'll see, it's almost overwhelming. You can access functions by entering commands at the DOS prompt or by navigating through menus. The systems screen defines where, when, and how you want to perform the backup. You select defaults for backup drives and types, format type, audio prompt signal, printer port selections, and backup frequency and classification.

TakeTwo Manager defines backup classifications as Regular, Once-Only, or Never, but you can override these settings and make further specifications for individual files or groups of files. Regular designates a backup whenever you modify a file or directory; Once-Only is best reserved for programs or executable files that don't change; and Never means just that. You can further refine your selection of files and directories from the file management screen.

In an attempt to be all things to all people, the package provides almost too many options and choices. The individual functions are not a problem to set up and use, but the overall package remains a bit inscrutable. For example, from the main menu backup screen you have the choice of selecting automatic, full, or modified backups. Each of these confirms or overrides the initial settings made during automatic installation or the changes made on system and file configuration screens.

To help you keep track of multiple configurations and backup procedures, *TakeTwo Manager* lets you save system configurations and includes detailed on-screen and printed reporting features, which are truly valuable for a systems

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***TakeTwo Manager*'s system configuration screen sets the default values and globally defines the backup process. Settings for backup frequency and classification may be more finely specified in the file configurations menu.**

manager. For a simplified approach, you can set the system and file configurations, make a batch file with the appropriate command string, and run it once a day for consistent backups.

TSR FILE MANAGER

TakeTwo Manager's file manager can run as a TSR and functions in concert with the backup program. It has more features than the file configuration screen and allows you to perform normal DOS operations such as making and removing directories, copying and deleting files, and renaming files or directories. Similar to *The Norton Backup* and *Central Point Backup*, *TakeTwo Manager* includes functions for recovering and wiping files, printing and viewing individual files, directories, and trees, finding and moving files, and altering file attributes.

The file manager lets you restore individual files from a previous backup and append a footnote to a file. Useful as a reference for backups and restores, this feature lets you attach a 50-character annotation to the directory listing of a file.

On PC Magazine Labs tests, we set *TakeTwo Manager* for optimum performance with buffers equal to 32 and the file verify option turned off. (The program does not compress files.) *TakeTwo*'s restoration of the 11MBs of test data was about 2 minutes slower than backup of the same material. However, a performance time of 9 minutes 11 seconds is actually slower since the program kicks out to DOS to format the disk before resuming backup. This takes an average of 1 minute 7 seconds per disk. While preformatted disks are not required, formatting is not really an unattended function. If you factor in the format time, the backup time converts to 20 minutes 21 seconds. To the program's credit, it avoided all the traps laid for it on our pass/fail tests.

While *TakeTwo*'s extensive functions and unique reporting abilities could well serve a PC systems manager who needs to administer a range of backup needs, other packages we evaluated do essentially the same job with greater speed and disk-saving compression routines. ■

Barry Simon and Edward Mendelson are contributing editors of PC Magazine. *Greg Pastrick is a free-lance writer and frequent contributor to* PC Magazine.

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"...a godsend...it's quick and easy enough to make backup, finally, a daily habit."
—*PC/Computing*

"Norton Backup clearly excels in ease of use, yet it doesn't compromise performance or features."
—*PC World*

"The Norton Backup has all the features you'll need to make the chore of backing up your hard disk a convenient and reliable one...it may even help you pick up the backup habit."
—*InfoWorld*

"Only Norton lets you back up multiple logical drives in a single step—a boon for users with partitioned hard disks."
—*PC World*

"Norton Backup is impressively fast...offers a high level of reliability and convenience at moderate cost."
—*InfoWorld*

"...its slick on-line help system makes the manual superfluous. [It] easily earns our Best Buy award."
—*PC World*

"Norton Backup ran smoothly and without error. We fed it faulty disks, disks of the wrong density, and already-filled disks from the same backup set, and it handled our forced errors without a twitch, popping up error messages that explained the problems clearly."
—*InfoWorld*

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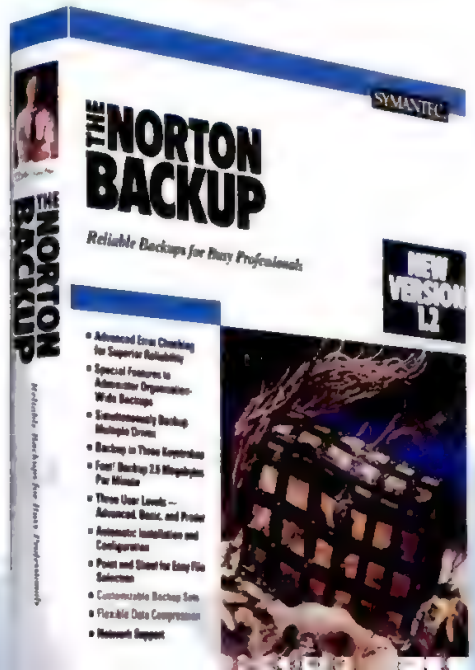
—*PC World*

"...the program that coddles you and your data better than any other... surpasses the speed of its fastest rival, Fastback Plus."
—*PC Magazine*



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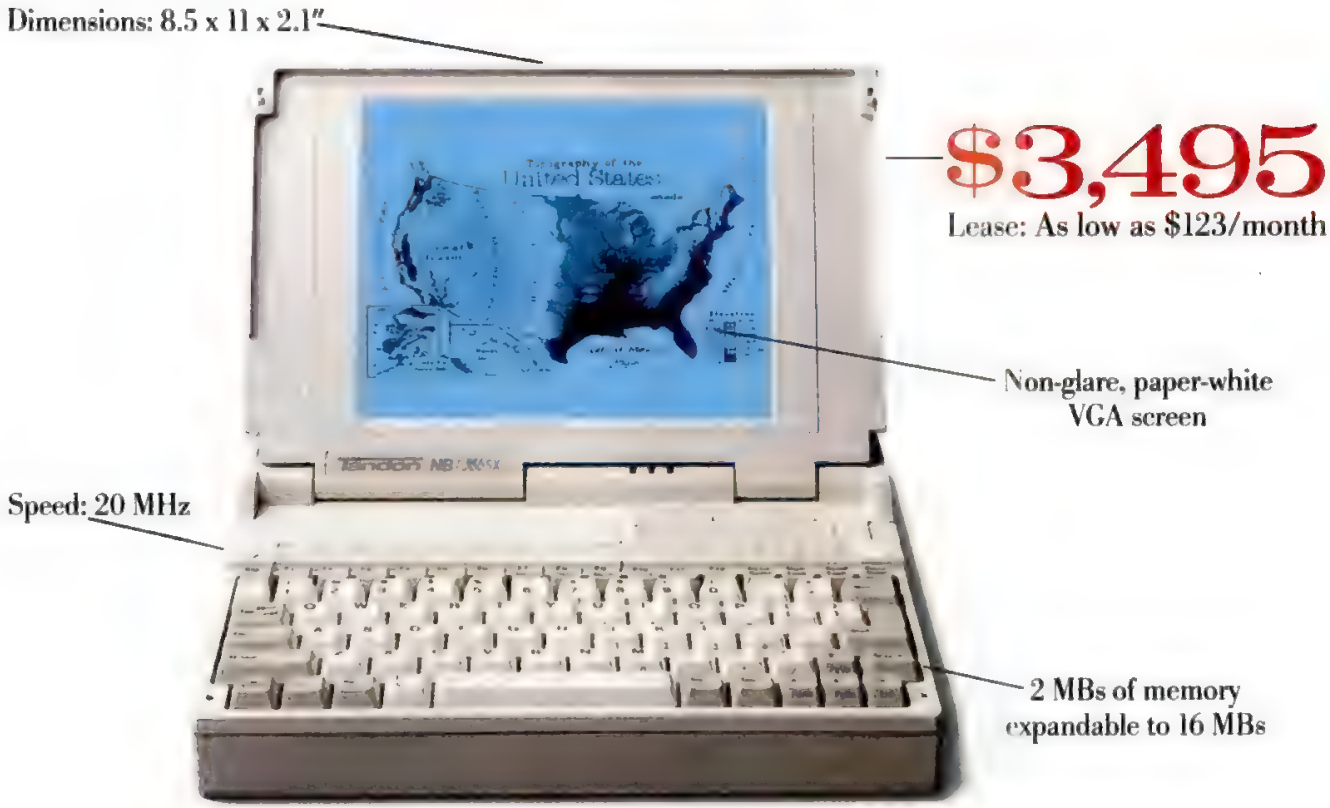

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Base RAM	2MB	2MB	2MB
Hard Drive	30MB	30MB	20MB
Hard Drive Option	60MB	60MB	40/60MB
Screen	VGA	VGA	VGA
Dimensions	8.5"D x 11"L x 2.1"H	8.5"D x 11"L x 2.2"H	8.5"D x 11"L x 1.8"H
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*List prices published by Hard Facts, Beverly, M.A., January, 1991
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SL486/25

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Tandon SL 386sx/20

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	9600V42	9650V32	2400V42	2400MNP	2450MNP	MB2400EX	MB2450	MB2295F	MB2250F	MC2450MNP	MC2450
External/Internal	EXT	INT	EXT	EXT	INT	EXT	INT	INT	INT	INT*	INT*
FLASHlink Communications Software	opt	yes	opt	opt	yes	opt	yes	yes	yes	yes	yes
Front panel LED's	yes	n.a.	yes	yes	n.a.	yes	n.a.	n.a.	n.a.	n.a.	n.a.
Selectable COM Port (1-4)	n.a.	yes	n.a.	n.a.	yes	n.a.	yes	yes	yes	yes*	yes*
MNP (up to Level 5) in Hardware	yes	yes	yes	yes	yes	–	–	–	–	yes	–
MNP (up to Level 5) in Software	–	–	–	–	–	opt	yes	yes	yes	–	yes
CCITT V 42/bis	yes	–	yes	–	–	–	–	–	–	–	–
Maximum Data Throughput (bps)	38,400	19,200	9600	4800	4800	4800	4800	4800	4800	4800	4800
SENDFAX Capabilities (bps)	–	–	–	–	–	–	–	9600	4800	–	–
Hayes®/AT Command Compatible	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
PRICE	$699	$599	$249	$229	$189	$199	$159	$199	$189	$299	$239

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CIRCLE 319 ON READER SERVICE CARD

486/25: Newly Affordable Power

by M. David Stone

The only thing better than a fast PC is a fast, reasonably priced one. 25-MHz 486s nearly fit the bill. For just 15 to 25 percent more cash, you can get about 10 to 15 percent more performance than with a 386/33.

Once the hottest chip on the block, Intel's 25-MHz i486 has dropped a notch in relative positioning since we last looked at 486/25-based PCs. Now the 486/33 takes on the most power-greedy desktop and network applications. But in ratcheting down one notch, the 486/25 has not just lost its claim as top dog—it's also lost its stratospheric price. And it's gaining a claim on a more mainstream, though still high-end, audience.

IN THIS OVERVIEW

- Acer 1170
- Acer 1200
- ACMA 486/25I Engineering Workstation
- ACMA 486/25E Engineering Workstation
- Advanced Logic Research BusinessVEISA
- AGI 4100A
- Amax 486 EISAmax
- American Research Corp. Skyscraper 486/25c
- Apricot Qi 900
- Austin Winstation 486/25e
- Blue Star 486/25c
- Boss 486 Model 4625
- Bus 486-25
- C^2 486-25
- Cheetah Gold 425
- Club 486 Hawk II
- Computer Market Place Ultra 486
- Copam 486/25 EISA
- CSS MaxSys 486 MTE/25
- Dataworld Data 486-25
- Dell System 425TE
- DTK Feat-2502
- Dynamic Decisions Dynex 486 ISA
- Dynamic Decisions Dynex 486E
- Dyna Work Master 486 25 Cache
- Dyna Work Master 486 25 Cache EISA
- EPS 486/25 Tower
- Hewlett-Packard HP Vectra 486
- HiQ 425i

PHOTOGRAPHY: THOM O'CONNOR

When *PC Magazine* first looked at the 25-MHz 486 (see "The First 24 486/25 PCs: Giant Step or Stepping Stone?" *PC Magazine*, September 11, 1990), we suggested that it was only the first step to higher power. After all, we reasoned, the price-is-no-object crowd would certainly buy the 33-MHz 486s that were appearing even then, while the performance difference between 386/33 and 486/25 didn't justify the price gap for those who didn't need the 486's built-in math coprocessor.

In our tests of 85 486/25 systems to date (including the 19 EISA, 40 ISA, and 3 MCA systems in this overview and the next), we see an average performance difference between the 386/33 and 486/25 of about roughly 10 to 15 percent on PC Magazine Labs' Instruction Mix benchmark tests.

Compared with this performance boost, the price gap between similarly equipped 386/33- and 486/25-based systems seemed unreasonably high when we first looked at 486/25s: typically about a third more for otherwise identical systems from any given vendor. The bottom line: For the standard 486/25 configuration we use in the current overview—which includes 8MB RAM, a 200 to 300 MB hard disk, and VGA or Super VGA video subsystem—you would have had to pay about $5,000 nine months ago, compared with about $3,700 for a 386/33 from the same vendor.

25-MHz 486-BASED PCs: INDEX

Model	Bus	Price (standard configuration)	80486 Instruction Mix test score (seconds)	*PC Magazine* review (Issue and page number)
				SEPT. 11, 1990
ACMA 486/25	ISA	$5,499.00	1.42	101
Amax 486/25 Power Station	ISA	$5,499.00	1.46	101
AST Premium 486/25	ISA	$10,944.00	1.49	103
Blackship 486/25	ISA	$5,636.00	1.46	104
Club AT Hawk II	ISA	$5,795.00	1.46	107
CompuAdd 425	ISA	$5,670.00	1.47	111
Computer Market Place Ultra 486-25	ISA	$4,497.00	1.46	112
CSS MaxSys 486T/25	ISA	$9,892.00	1.48	125
Dataworld Data 486-25	ISA	$6,265.00	1.47	130
Destiny 486/25	ISA	$8,945.00	1.46	159
Everex Step 486/25	ISA	$10,525.00	1.46	134
Gateway 2000 486-25	ISA	$4,970.00	1.46	136
Micro Express ME 486-25	ISA	$5,570.00	1.46	136
Micro Telesis MT 486DX	ISA	$4,999.00	1.50	140
Mitsuba 486-25	ISA	$8,525.00	1.46	151
Northgate Elegance 486/25	ISA	$5,830.00	1.45	153
Osicom Executive 486/25	ISA	$7,000.00	1.57	156
Polywell 486/25	ISA	$6,150.00	1.48	159
SAI 486/25	ISA	$5,495.00	1.47	160
Swan 486/25	ISA	$6,024.00	1.46	164
Syntrex 486/25C	ISA	$11,119.00	1.50	167
Transource Version 486	ISA	$5,295.00	1.46	168
Tri-Star 486/25	ISA	$5,555.00	1.46	170
Twinhead Superset 600/425	ISA	$6,995.00	1.47	172
				JUNE 26, 1990
ALR PowerCache 4	MCA	$14,989.00	1.46	122
ALR PowerCache 4e	EISA	$14,989.00	1.42	122

—Editors' Choice

A BETTER BUY

The 486/25 is a more reasonable choice now than when it first hit the market. Performance hasn't changed, of course, but the prices are falling even faster than usual in this predictably deflationary industry.

For most vendors, 486/25-based computers today cost less than similarly equipped 386/33-based computers did in mid-1990. Gateway 2000, for example, whose system we looked at in our last overview, will sell you a 486/25 system today for $200 less than the identically equipped 386/33 would have cost you last year.

Just as important, the extra money you'll pay for a 486/25 is now more in line with the additional performance you'll get. Some vendors still charge a 35 percent premium for the 486, but a 15 to 25 percent difference is more common. Given the generally lower prices, that difference often translates to a relatively small $400 to $500. That's well below Intel's current price for a 33-MHz 80387 coprocessor.

Clearly, you should consider a 486/25 if you need the on-board math coprocessor for heavy-duty number crunching or CAD/CAM applications. Of course, your software must take advantage of the coprocessor; many programs ignore it altogether. Others, notably *Lotus 1-2-3*, will recognize a coprocessor's presence but generally won't improve performance. Still others, such as *AutoCAD*, can use the coprocessor to speed calculations and give faster performance. But at this level, you may be able to justify the price even if you don't need the coprocessor.

The 486/25's new lease on life comes at least partly courtesy of Intel's pricing of the chips themselves. In May 1990, Intel's price for the 486/25 was $800. In the first quarter of 1991, that price fell 16 percent, to $671. Over the same time period, the price on the 386/33 dropped only 6 percent, from $227 to $214.

NEW CHIP ON THE BLOCK

The 486/25 may lose out on a price-performance basis to Intel's new 20-MHz 486SX—and sooner than later (see the sidebar "486SX: One Step Forward, Two Steps Back"). Basically a 20-MHz 486 without an on-board coprocessor, the 486SX/20 will carry a retail price of $269—little more than the 386/33. But Intel claims the new chip's performance will be closer to the 486/25 than to the 386/33. In fact, for 32-bit operations, Intel says the 486SX/20's performance will be equivalent to a 386 chip running at 45 MHz. If system prices parallel chip prices, then 486SX/20-based systems should sell for little more than 386/33-based systems. At least four systems are already available: See our First Looks reviews of 486SXs from AST, ALR, American Mitac, and IBM in this issue.

When judging the 486/25, remember that the performance gains we measure

are far more conservative than Intel's claims. Intel's numbers assume heavy reliance on 32-bit operations, while the PC Labs' benchmark tests give greater weight to 16-bit operations. The performance difference you actually see in real-world use will depend on the software you use. Relatively few programs take advantage of 32-bit operations, though *AutoCAD*, for example, does. And, Intel points out, so will the 32-bit version of *Windows* that's still a year or two off.

Even if you accept Intel's higher numbers, note that processor speed is largely irrelevant for many operations. For example, reading from and writing to disk involves your disk drive and controller more than your processor. And in many applications, greater processor speed will matter far less than a faster drive or a caching controller.

In judging price and performance for the current crop of 486/25s, you'll have to make allowance for the buses in each. Note that we've included EISA, ISA, and MCA systems in this overview. In fact, for those companies that sent us both an EISA and ISA system, we've covered the two in the same review, comparing them point for point.

PICK YOUR PRICE

The direct comparison will be particularly helpful if you're not already committed to a specific bus. You'll be able to compare the current status for each bus, with current prices, performance measurements, and trends for each.

Prices for these systems fall neatly into four categories, based on the 16-bit (ISA) and 32-bit (EISA and MCA) bus types and the two distribution channels. For EISA and MCA systems sold by dealers, list prices for a system with 8MB of RAM, a 200MB hard disk, and a color Super VGA display range from about $6,000 to over $13,000. With a typical 25 percent discount, that's roughly $4,500 to $9,800. Prices for mail-order EISA systems fall well inside that range, at about $6,500 to $7,800. (In either channel, the average *selling* price is roughly $7,000.)

As you would reasonably tend to expect, ISA-based systems generally cost less—roughly $4,200, regardless of the distribution channel. For those systems sold through dealers, virtually all list prices range from about $5,500 to $7,600, yielding street prices that are likely to run from $4,100 to $5,700. Here too, the mail-order prices are more tightly grouped; they run from roughly $3,700 to $4,600.

For vendors that offer a choice of buses, the price difference between the two models ranges from only $1,000 to $2,500, substantially lower than the average difference between the two buses. This apparent discrepancy would disappear if more vendors offered both EISA and ISA systems. However, few offer that choice, and the ones that sell EISA systems tend to do so only at the high end of the EISA price range.

Even the $1,000 to $2,500 gap is misleadingly large, widened by differences in our configuration, such as our acceptance of caching disk controllers in both EISA and MCA systems.

MASTERING THE BUS

One benefit of the 32-bit data path is the ability to take advantage of bus mastering—a technique that increases system efficiency by letting a card take control of the system momentarily. The 16-bit ISA data path has limited bus-mastering capability, but it allows only one bus master card, so the feature is seldom used. Since EISA and MCA buses will let you put a bus master card in every slot, cards can take advantage of the feature without risking interfering with each other.

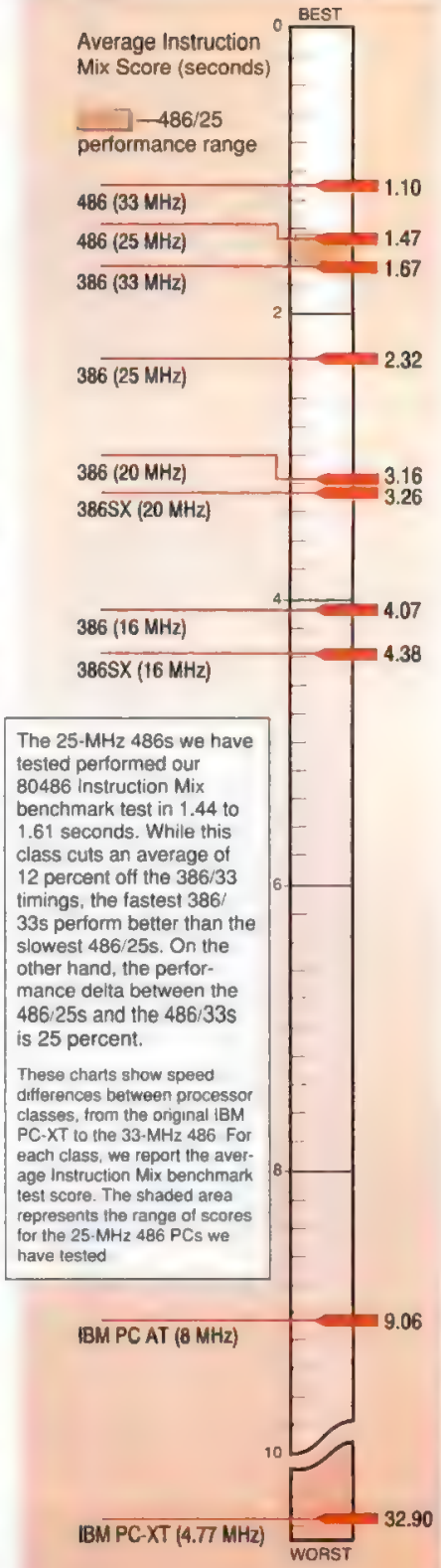
Because most EISA bus master disk controllers also include an intelligent cache, we allowed these systems to include caching controllers with up to 1MB of RAM on board. With ISA systems, we insisted on a noncaching controller, with one exception. The $10,489 Cheetah Gold 425's minimum configuration includes a 512K caching controller, and the vendor claims that the system's bus is designed to optimize that card.

Whether EISA, ISA, or MCA, a caching controller with 512K to 1MB of RAM will necessarily add several hundred dollars to the price of a system. UltraStor's Ultra-22C caching controller, for example, is $895 with 512K RAM, compared with $250 for the company's noncaching board.

PERFORMANCE ISSUES

Caching disk controllers also have an obvious effect on disk performance. Not surprisingly, all of the EISA systems with bus-mastering caching controllers easily outperformed all of the ISA systems without caching controllers. In fact, the worst performance for a caching controller on PC Labs' disk access test was far better

PROCESSOR PERFORMANCE COMPARED



The 25-MHz 486s we have tested performed our 80486 Instruction Mix benchmark test in 1.44 to 1.61 seconds. While this class cuts an average of 12 percent off the 386/33 timings, the fastest 386/33s perform better than the slowest 486/25s. On the other hand, the performance delta between the 486/25s and the 486/33s is 25 percent.

These charts show speed differences between processor classes, from the original IBM PC-XT to the 33-MHz 486. For each class, we report the average Instruction Mix benchmark test score. The shaded area represents the range of scores for the 25-MHz 486 PCs we have tested

than the best performance for a noncaching controller in an ISA system. A more interesting result is that even those EISA systems without caching controllers managed to outperform almost all of the ISA systems, and in some cases by noteworthy margins.

The apparent, though by no means definitive, conclusion is that all other things being equal, the EISA bus offers a slight performance advantage over the ISA bus when paired with a bus-mastering controller.

In choosing a system, though, keep in mind that most EISA benefits are still more promise than reality. In particular, the only EISA-specific cards are still disk controllers and network adapters. And our tests show that a 16-bit ISA video board can perform significantly worse in an EISA system than in a similar ISA system from the same vendor. EISA may turn out to be the way to go for the future, but it's not the obvious choice yet. And given the price premium for EISA systems, the ISA bus still fares better than EISA on any price-performance rating, at least in the DOS environment.

Other than disk performance, our tests show no patterns at all. As you might expect, processor and memory results were bunched tightly together for all systems—EISA or ISA. Much the same comment applies to video performance. Our tests also show that at least in the single-user DOS environment, there is little or no performance benefit from adding expensive external cache to the 8K internal cache of the 486.

REVIEW CRITERIA

As already indicated, our requirements were slightly different for EISA and MCA systems than for ISA systems. EISA and MCA systems could include a caching controller. ISA systems could not, unless there was an overriding reason for the exception. Nevertheless, we made an effort to keep the systems as closely matched as possible.

In all cases, we asked the manufacturer for a production unit of the 486/25, 8MB RAM, external cache if available, a 200MB to 300MB hard disk, at least one high-density floppy disk drive, VGA or Super VGA video subsystem, one parallel and two serial ports, and DOS 4.01 (or 3.3). Because these are high-end systems, we did not require an FCC Class B rating, which denotes acceptability for home use.

We received 62 appropriate systems from 52 vendors—so many that we chose to divide this overview into two parts. In this issue, you'll find reviews of 29 systems, including 11 EISA systems, 17 ISA systems, and 1 MCA. In part 2, we will review systems from American Mitac, CUI, IBM, Industrial Data Systems, Insight, International Instrumentation, KRIS, Master, Matrix, Mega, Micro Express, National Micro Systems, NCR, Novacor, PC Brand, Peregrine, Polywell, Reason, SAI, Softworks, Tangent, Tenex, Touche, Treasure Chest, Ultra-Comp, Unisys, and Zeos.

Ten vendors said that they were shipping 486/25s but did not send us production systems before our deadline. These included Digital, Eltech, Maxtron, Memorex Telex, Proteus, SIA, Tandon, Tatung, Topline Technologies, and Twinhead.

NEW LOOK FOR TEST RESULTS

by Bill Machrone

As readers continually search for the perfect PC, we're continually searching for the perfect way to describe it to you. This issue introduces a new look for our benchmark test results. Accompanying each computer review is a high-low-average graph that shows the fastest and slowest times we've recorded in a product category, the average for the group, and the performance of the machine in question against the group. We present instruction mix, memory speed, disk performance, and video performance in one compact, easy-to-read graph.

In the new graph, colored bars show the range of performance within a product category, and arrows indicate the actual performance of each machine against the group. The graphs also show the relative differences between tests. For example, processor speed varies little among machines in the same category, while video and disk performance show the broadest range of scores. Therefore, you'll see a short colored bar for processor scores and longer bars for disk and video scores.

For the high-low-average graph, we've created a composite number from our standard disk performance tests and video tests. The single disk test number combines the DOS large-record and small-record tests.

We've eliminated the BIOS Disk Seek test because many high-performance disk subsystems ignore seeks when not accompanied by reads or writes and return a time of 0 on the test. The video tests are heavily weighted toward 16- and 256-color graphics rather than text mode. Note that these tests bypass the manufacturers' drivers, which are subject to frequent changes and updates. They test the actual performance of the video controller and the card's interface to the bus.

THE BIG PICTURE

We've retained our trademark 3-D bar graphs and replaced our two-dimensional bar graphs with an easy-to-read numeric table of test results. The 2-D bar graphs that previously compared individual machine results within each testing category duplicate the information found in the new high-low-average graphs.

The 3-D chart, more than any other type, depicts the shape of the data and allows cross-comparisons not possible with other graphical representations. We don't expect anyone to pick off data points from the 3-D graphs, which is why we provide the numeric test results, too. Rather, the 3-D bar graphs highlight exceptionally good or exceptionally bad performance within a group.

We've also introduced a graph that shows the range of instruction mix scores for every processor, from the original 8088-based XT to the 33-MHz 80486. This new element will allow you to gauge the performance gains you can expect when upgrading to a new processor level.

We think you'll find our new presentation useful in isolating and analyzing the performance categories that are important to you and for comparing the performance of each machine to its competition. In our next issue, in the conclusion of this two-part series on 486/25 PCs, we'll introduce a powerful new graph that shows the relationship between performance, features, and price. ■

SYSTEM CONFIGURATION AND PERFORMANCE: A GUIDE TO THE GRAPHICS

BENCHMARK TESTS

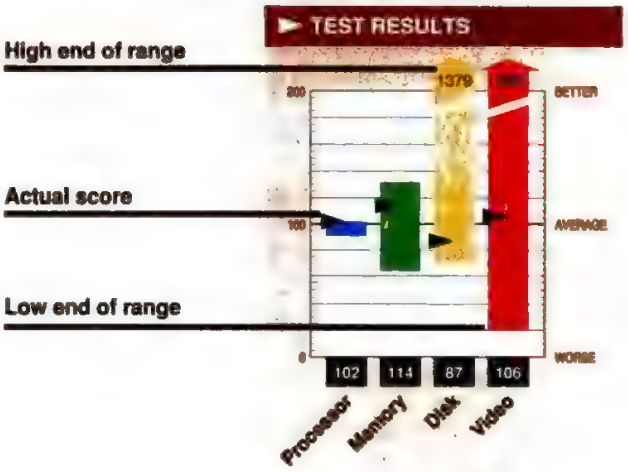
The Bars
Each colored bar represents the **range** of all 486/25 test scores, from fastest to slowest. *The longer the bar, the wider the range.* If the best score is more than twice as fast as average, an upward-pointing arrow will appear atop the colored bar.

A black arrow on each bar represents the given system's **position** within the range. *The higher the arrow, the better the performance.* If a system performs more than twice as fast as average, the black arrow appears at the top of the bar, pointing upwards.

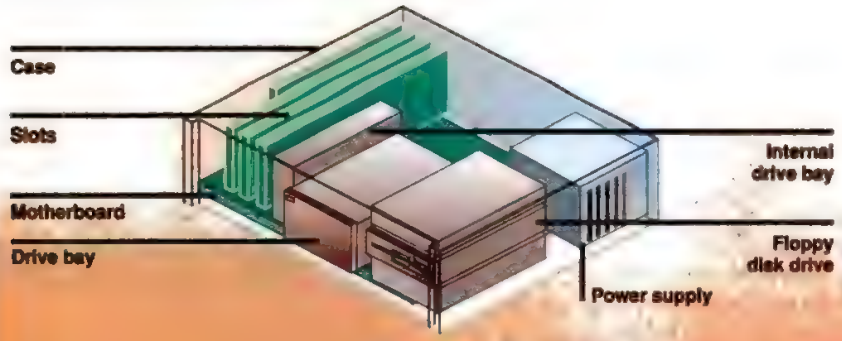
The Boxes
A normalized score appears in the box below each colored bar. To derive this figure, we calculated the average score for all 486/25s reviewed in *PC Magazine*, September 11, 1990, and June 11, 1991, as well as those to be published in the June 25 issue. We then divided this average by the score of each machine in turn and multiplied by 100.

Thus the average score is 100; a number greater than 200 indicates that a system performed the test in less than half the average time; a number smaller than 50 indicates that the system took more than twice as long to complete the test.

A table of **actual scores** accompanies the three-dimensional bar charts.



INTERIOR CONFIGURATION DIAGRAM



Case Options include desktop, tower, mini-tower, small-footprint, and slimline.

Slots The number and length of cards represent the number and length of slots on the motherboard.

Drive bay A hard disk face plate indicates external access to a bay. Options include full-height, half-height, third-height, and 3.5-inch.

Floppy disk drive A face plate indicates that either a 1.44MB or 1.2MB floppy disk drive was installed in our tested system.

We did not review systems previously tested in PC Labs unless the vendor had made a substantial change since the earlier review was published. Club AT's Hawk II, for instance, closely resembles the one reviewed in our September 11, 1990, issue. However, the company has made motherboard changes that we considered significant enough to warrant reviewing the unit as a new system.

PHYSICAL FEATURES

As you might expect, most of the 486/25s in this overview are targeted more as file servers than as desktop PCs. The vast majority of units in this review came in tower cases with enough drive bays for a storage-hungry network. Desktop systems, and even a handful of small-footprint systems, are available, too—your decision depends mostly on how much drive space you need.

The smallest number of bays on a tower in this overview, for instance, is five half-heights, a variation you'll find on two EISA systems. At the other extreme, one unit has eleven half-height bays. Six to eight bays should be enough for most network servers.

Desktop systems show far less variation than towers, with five half-height bays the most common arrangement. The smallest number of bays in an AT-style desktop is one full-height and three half-height, a near equivalent of five half-height bays. Naturally, the small-footprint systems offer the least expansion room and usually depend heavily on 3.5-inch drives. When you judge the value of the small bays, though, keep in mind that the Quantum 3.5-inch 425MB hard disk made its PC Labs debut in this overview, giving this form factor a new level of clout.

Just as important as drive bays for

486SX: One Step Forward, Two Steps Back

by M. David Stone

Intel is set to introduce a new chip to split the difference between the 386/33 and 486/25 in price and performance. Best described as a 486 without a math coprocessor, the 486SX/20 is priced at $258. That's just $52 more than Intel's current 386/33 price, but about $540 less than the 486/25. And although it runs at a slow 20 MHz, Intel claims that the 486SX will outperform the 386/33. Intel has always billed the 486, or, more formally, the i486 DX, as a member of the 386 family, emphasizing the similarities rather than the differences. But the 486 is more than a 386 with an on-board math coprocessor.

The two most important differences between the 386 and 486 are the 486's 8K internal cache and its more efficient processing: The 486 executes all instructions in fewer clock ticks than the 386, with particular efficiency for 32-bit instructions. Also, there are four additional 32-bit instructions in the 486. In the DOS environment, we find the 8K internal cache is enough. And although the high efficiency for 32-bit instructions will affect performance for only a few programs now, it will have an increasingly important performance impact as more programs take advantage of the 32-bit capability—including, for example, the promised 32-bit version of *Windows*.

For the potential 486 buyer, the question is whether the 486DX's additional performance features are enough to make paying for the math coprocessor worth it even if your software doesn't use it. That question is even more relevant now that American Micro Devices (AMD) is prepared to release 40-MHz 386-clone chips onto the market en masse.

The 486SX is Intel's answer. The new chip offers all the features of the 486DX minus the on-board coprocessor. And in case you change your mind about needing the coprocessor, Intel has also introduced a 487SX math coprocessor.

Of course, a 20-MHz 486SX system should offer slower performance than a 25-MHz 486DX, but the difference may be less than you expect. Intel claims the 486SX/20 will offer performance equivalent to a 45-MHz 386—if there were such a chip.

More precisely, going from a 386/33 to a 486SX/20, Intel's figures show a performance boost of better than 40 percent. But remember that Intel also claims a better than 70 percent improvement between the 386/33 and 486/25. Given the 12 percent speed difference we measure between the 386/33 and 486/25, we expect to find an improvement closer to 5 percent on PC Magazine Labs' Instruction Mix test. But the point is that 486SX systems will split the performance difference between 386/33 and 486/25, at a price that is likely to be much closer to that of the 386/33 systems.

Significantly, we found several computer vendors that plan not merely to announce 486SX systems close on the heels of the Intel announcement, but to be in full production shortly thereafter. And there will be several 486SX systems available on the market by the time you read this.

One last note: The 487 is basically a 20-MHz 486. Put a 487 into a coprocessor socket and it becomes the processor, effectively shutting off the 486SX. A vendor could even design a board that would work with the 487 by itself, according to Intel. However, given that the suggested list price for the 487 is nearly identical to the price of the 486SX, it's not clear that such a design would be the most cost-effective solution. As always, stay tuned for further developments. ■

expansion is the number of open slots. One pattern emerges in this issue: ISA systems are far more likely than EISA systems to have five or more slots available in our standard configuration. Most EISA systems' bus-mastering, caching controllers don't offer a floppy disk controller on the same card, so the second controller takes an extra slot. As a result, only a little more than half of the EISA systems—as opposed to the overwhelming majority of ISA systems—have five or more slots available in our standard configuration.

ESDI VS. SCSI VS. IDE

The most popular hard disk interface seems to be changing somewhat. In our first look at 486/25s, the overwhelming majority of drives were ESDI, with a smattering of SCSI, IDE, and even RLL drives. In this overview, we find a new pattern, based on the system bus. Among ISA systems, there is a close balance between ESDI and IDE drives, with a small representation of SCSI. In EISA systems, on the other hand, vendors chose either ESDI or SCSI, as bus master IDE drives are not available.

Another important difference between ISA and EISA machines is that, as a group, EISA systems have larger maximum memory sizes—a potentially important consideration for a network server or for non-DOS environments. Virtually all EISA and MCA systems support 64MB or more of RAM, with the Dynamic Decision Dynex 486 EISA allowing up to 96MB. Most ISA systems can handle up to 16MB.

In most other ways, the ISA and EISA systems are more alike than different. For example, in both groups, you'll find more systems with 256K maximum cache RAM on the motherboard than with 128K maximum or less. Only the ISA systems include representatives with no external RAM cache available, but that may be only because there are more ISA systems covered here than EISA systems, yielding greater variability.

OUR CONTRIBUTORS

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Stephen L. Bender is a writer based in New York. ■

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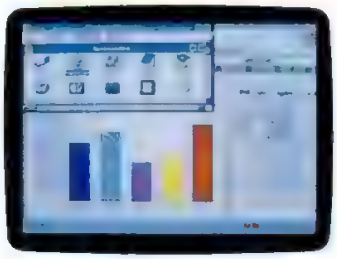

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EDITORS' CHOICE

• **Dell System 425TE**

Of the 29 ISA, EISA, and MCA 486/25 PCs reviewed in this issue, only one, the Dell System 425TE, earns Editors' Choice. Seven other systems, however, deserve an honorable mention for their combination of features, price, and performance: EISA PCs from ACMA, Austin, and Hewlett-Packard, and ISA systems from ACMA, Club American Technologies, and Dataworld.

You don't have to pay dearly for EISA when the $7,818 Dell System 425TE provides everything a file server should have (including the 8MB of RAM, 210MB IDE hard disk, and VGA display that we required of all systems for our standard configuration). With its built-in I/O, VGA, and IDE hard disk circuitry, the highly integrated, Dell-designed motherboard has plenty of room for expansion. This system also comes with the most spacious case we've seen, which allows room for 11 drives. Dell is actively pursuing the server market; by the time you read this review, the company will be selling a drive array option to compete with Compaq's Systempro. Dell's PCs are priced somewhere between clones and machines from top-tier vendors, but most important, the Dell System 425TE is a reliable EISA tower from a company with a superior record of service and support.

Austin and ACMA deserve honorable mention for producing solid, reasonably priced EISA machines. Both the ACMA 486/25E Engineering Workstation ($6,595) and the Austin Winstation 486/25e ($6,995) feature name-brand components, good expandability, and a fine set of service and support policies.

If money is no object, take a serious look at the Hewlett-Packard HP Vectra 486. The Vectra, a superbly constructed EISA tower, sells for $13,395. Even after a 25 percent discount, that's still more than $10,000—though that's inexpensive compared with other first-tier makers like Compaq and IBM. Like those two, Hewlett-Packard makes no pretense of targeting anyone but the corporate network customer. For the money, you'll get a server that you can plug in and forget. By the time this review ships, Hewlett-Packard will also be selling this system with SCSI-2 disk drives at no extra charge.

AFFORDABLE ISA

Any high-powered system that sells for less than $5,000 and has FCC Class B certification deserves praise. In this overview, we saw two such machines: the Dataworld Data 486-25 and the Club 486 Hawk II. Both deserve honorable mention, though neither stands out as a sure Editors' Choice winner.

The Dataworld Data 486-25 ($4,545) is a fine desktop choice, with good expansion room, top-quality componentry, and on-site service options. The Data 486-25's desktop case has as much room as you would need in a single-user environment, and its performance rivals that of comparable ISA systems.

The Club 486 Hawk II ($3,995), like the 33-MHz Club Hawk IIITi (Editors' Choice, *PC Magazine*, February 12, 1991), has one of the best combinations of features, performance, and price in this group. And at $3,995 for a system with 8MB of RAM, more than 300MB of storage, and Super VGA color display, it's considerably less expensive than the 33-MHz version.

One last desktop ISA system to consider for your office: ACMA's 486/25I Engineering Workstation ($4,195) performed well all around and appears to be a solid contender, despite its lack of an FCC Class B rating.

All of these systems are worth considering, but you'll have another set of options—including some more Editors' Choice winners—when we review 33 more 25-MHz 486s in the next issue of *PC Magazine*.

Both the ISA and EISA categories offer FCC Class B ratings for just under half the systems in the group. As you might suppose, the Class B rating is far more likely to be found on the more expensive systems we tested. And in fact, this is the one consistent difference between low-priced and high-priced systems, regardless of the bus that is used. Since such machines require better radio frequency shielding and higher-quality construction, Class B certification applies primarily to systems intended for home use (so that you could use them without drowning out television programs).

As should be clear, the 29 systems included in this issue offer surprising variety in price, disk and video performance, and bus. And while any 486/25-based computer offers enough raw power to function as either a server or a high-powered workstation, you'll find systems that are tailored to match your needs. This class of computer won't be a bargain-basement item for some time yet, but you may find one at a reasonable enough price to justify putting it on your desk.

ACER AMERICA CORP.

Acer 1170
Acer 1200

by Alfred Poor

Acer America Corp. makes two 25-MHz 486 models, the ISA-based 1170 and the EISA-based 1200. While each has distinguishing details, aside from higher-than-

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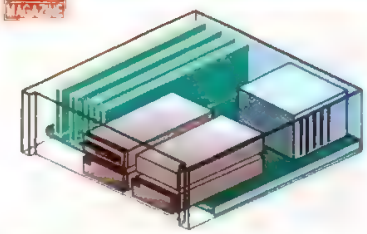

Acer 1170
Acer America Corp., 401 Charcot Ave., San Jose, CA 95131; 800-SEE-ACER.
List price (tested configuration): $7,814.
Memory and processor RAM cache: 8MB 80-ns. SIMMs.
Disk drives and controller: Maxtor 15-ms. 200MB IDE, 1.44MB floppy disk drive.
Display: ATI 512K 1,024 by 768 adapter, Acer 14-inch monitor.
Software: DOS 3.3, *Windows* 3.0 with mouse.

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average prices there is little in their performance or features that sets them apart from their competition.

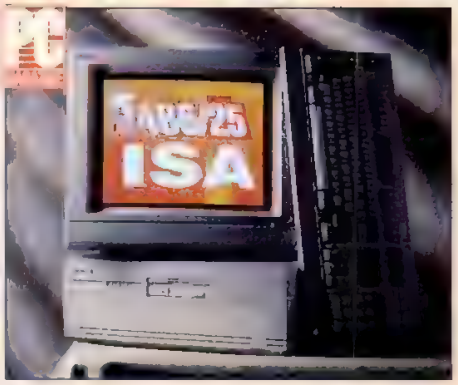
The 1170, which comes in a small-footprint case, carries a full-scale list price of $7,564 for its standard configuration. That includes a 200MB IDE hard disk, 8MB RAM, and a Super VGA display subsystem. The 1200 comes in what Acer calls a tower case (more on this in a moment) and costs $10,064 for the same configuration. The systems we tested came with upgraded monitors capable of 1,024 by 768 pixels, noninterlaced. This added $250 to the price of each.

LIKE PERFORMERS

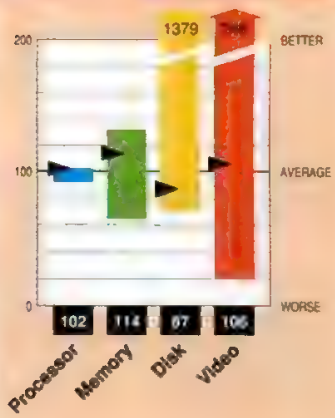
The 1200 has 128K of fast processor RAM cache. Even though its ISA counterpart has none, our DOS-based benchmark tests do not show any appreciable difference in performance between the two models. The EISA 1200 came with an optional 338MB SCSI drive (for a total system price of $10,563), but it performed only fractionally better than the 1170. The only apparent—albeit very minor—difference in performance between the two machines occurred on our video tests, where the EISA 1200 was a bit faster than the ISA 1170, even though both used the same 16-bit video board with an ATI chip set.

The 1170's small-footprint case saves you precious desk space, but at a cost. There are only four expansion slots in the machine, one of which can take only half-length boards because a full-length card would risk coming into contact with the computer's SIMMs. There are floppy disk

ACER 1170

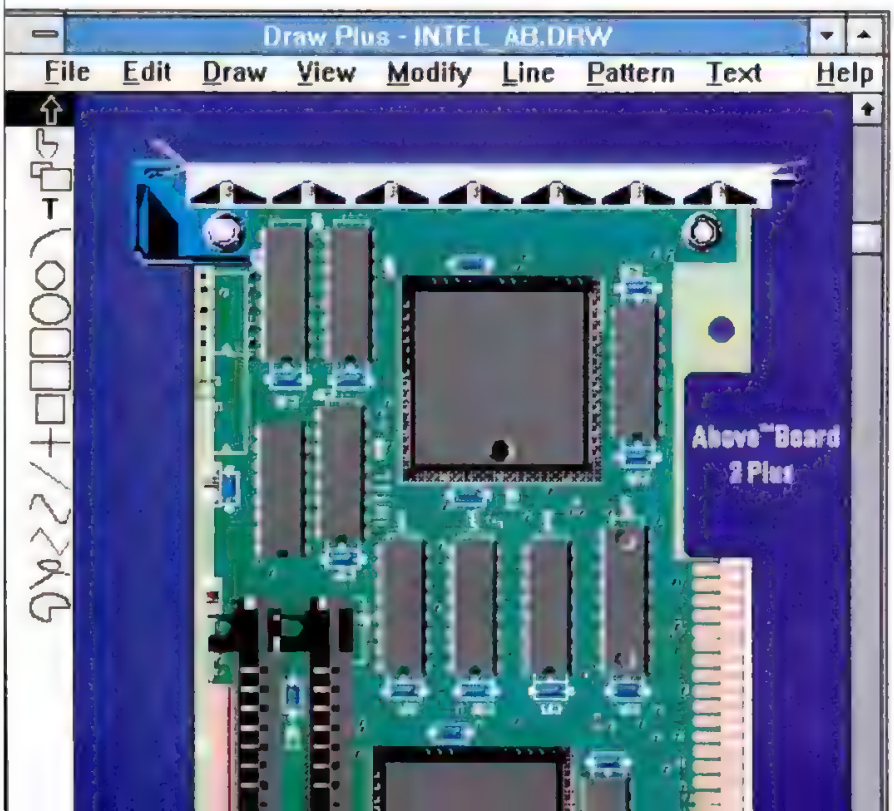


TEST RESULTS



In Short: The ISA-based Acer 1170 posted times very similar to those of its EISA sibling, the Acer 1200. Even without an external processor RAM cache, the Acer 1170's processor and memory scores were among the very fastest. The disk test result was comparable to those of other systems without caching disk controllers. This system's biggest handicap is its relatively high list price. The small-footprint case is convenient if you want to conserve space, but it also limits your expandability.

Free Window displays.



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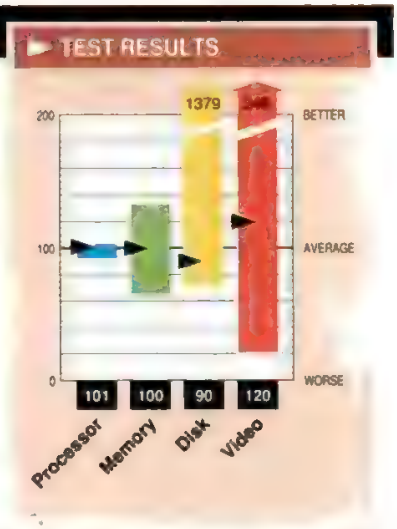
ACER 1200



In Short: The Acer 1200, with its EISA bus, performed marginally better than its ISA counterpart on both disk and video tests. Among the five EISA systems in this group that came without a caching disk controller, the Acer 1200's disk scores were the slowest. Video performance, however, was slightly faster than average. This system's tower case has one drawback: It is designed more like an AT case on its side, which makes access difficult.

and IDE connectors on the motherboard, but you will need to use one slot for a display adapter. This leaves but three 16-bit slots available. It won't take much to bump into this limit: simply adding a network card and any combination of scanner, CD-ROM, or tape drive interface cards would do the trick.

There are also limits to the number of installable devices. Two 3.5-inch bays are located on top; ours were occupied by an IDE hard disk and a 1.44MB floppy disk drive. Below them, another bay can take either a single 5.25-inch half-height drive or two 3.5-inch drives. Since many removable media drives (like tapes and CD-ROMs) come in a 5.25 form factor, the single 5.25-inch drive is potentially another limitation.

1200'S BETTER EXPANDABILITY

Thanks to its full-size case, the 1200 offers more room for expansion than the 1170. The motherboard has eight EISA expansion slots, though on a standard system two are taken up by drive and display adapters. The unit comes with a PSHF card, which combines a parallel port, two serial ports, an IDE hard disk connector, and a floppy disk controller on a single card. Our evaluation unit also had a SCSI interface card for the optional 338MB disk, leaving five slots open.

The 1200's case has two sets of drive bays: three accessible half-height, 5.25-inch bays and two more that are not accessible from the outside. (You can also mount full-height devices in either area if you choose.) Oddly, this tower case is actually a standard AT-size desktop case arranged to sit on its side, and it suffers because of it. While other tower cases are designed so that you can remove a side panel to gain access to the expansion slots and motherboard, the Acer 1200 requires that you lay the unit on its side so that you can slide the cover off. This defeats the main purpose of the tower case for those who need to open the case regularly.

Both computers came with the same video card, monitor, and keyboard. The video card is capable of noninterlaced resolution through 1,024 by 768 pixels; the AcerView 35 UVGA monitor keeps pace with it. Acer also sells the AcerView 33, a monitor capable of both 800 by 600 and 1,024 by 768 interlaced display, for $250 less.

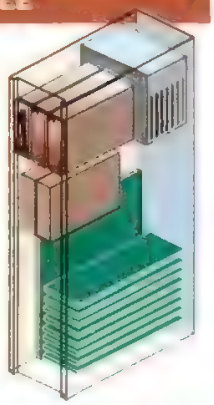
BACK TO THE DEALER

Acer America gives these units a two-year parts-and-labor return-to-depot warranty under which the machine must be packed up and returned to the manufacturer for repair. Some Acer dealers do offer optional on-site service contracts for these computers, but it is not part of the basic guarantee.

Ultimately, however, their prices outweigh whatever bright points these machines offer. Compared with the rest of this group, the 1170 and 1200 are no bargains. Some dealers may offer significant discounts, but even deep discounts are likely to bring them merely within range of other entrants' list prices. At least the Acer pricing policy is consistent: By trading down to a 33-MHz 386-based ISA machine, you save only $750 compared with the price of the 1170, which is commensurate with the drop in performance you'd expect.

These two Acer machines aren't standouts, except in price. The case designs present limitations to expandability and usability, and their average performance doesn't justify their high cost.

FACT FILE



Acer 1200
Acer America Corp., 401 Charcot Ave., San Jose, CA 95131; 800-SEE-ACER.
List price (tested configuration): $10,563.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Seagate 14-ms. 337MB SCSI, Bustek controller, 1.2MB floppy disk drive.
Display: ATI 512K 1,024 by 768 adapter, Acer 14-inch monitor.
Software: DOS 3.3, *Windows* 3.0 with mouse.

CIRCLE 397 ON READER SERVICE CARD

ACMA COMPUTERS INC.

ACMA 486/25I and 486/25E Engineering Workstations

by Bruce Brown

ACMA Computers has two competitively priced, competitively performing systems in this review, each called an ACMA Engineering Workstation. The only difference between the two systems' names is a single letter: I for ISA and E for EISA. At $4,195 for the 486/25I and $6,595 for the 486/25E, both of these systems are good deals.

In its standard configuration, the ISA model comes in a desktop case with 8MB RAM, a 210MB IDE or a 157MB ESDI

This is what the world's most powerful 486 system looks like.

ETMS,™ Everex Thermal Management System, makes this the first system to solve the high temperature and related reliability problems of current and future processors. A partition separates the cube into two compartments, independently cooled by SmartFans.™ One contains the CPU, one the drives. Baffles funnel cool air where it's most needed. Even the power supply is cool, because at 400 watts, it runs at a fraction of its capacity.

Cylindrical pin and tumbler locks keep unauthorized fingers out of the hardware. (And your data is equally safe, because we've built password protection into the firmware.)

Removable motherboard for instant upgrades, which we'll bring you as new technologies emerge.

All the full-length expansion slots you'll ever need—12 altogether, including 10 EISA slots. The cube is also available in 8 slot ISA configurations.

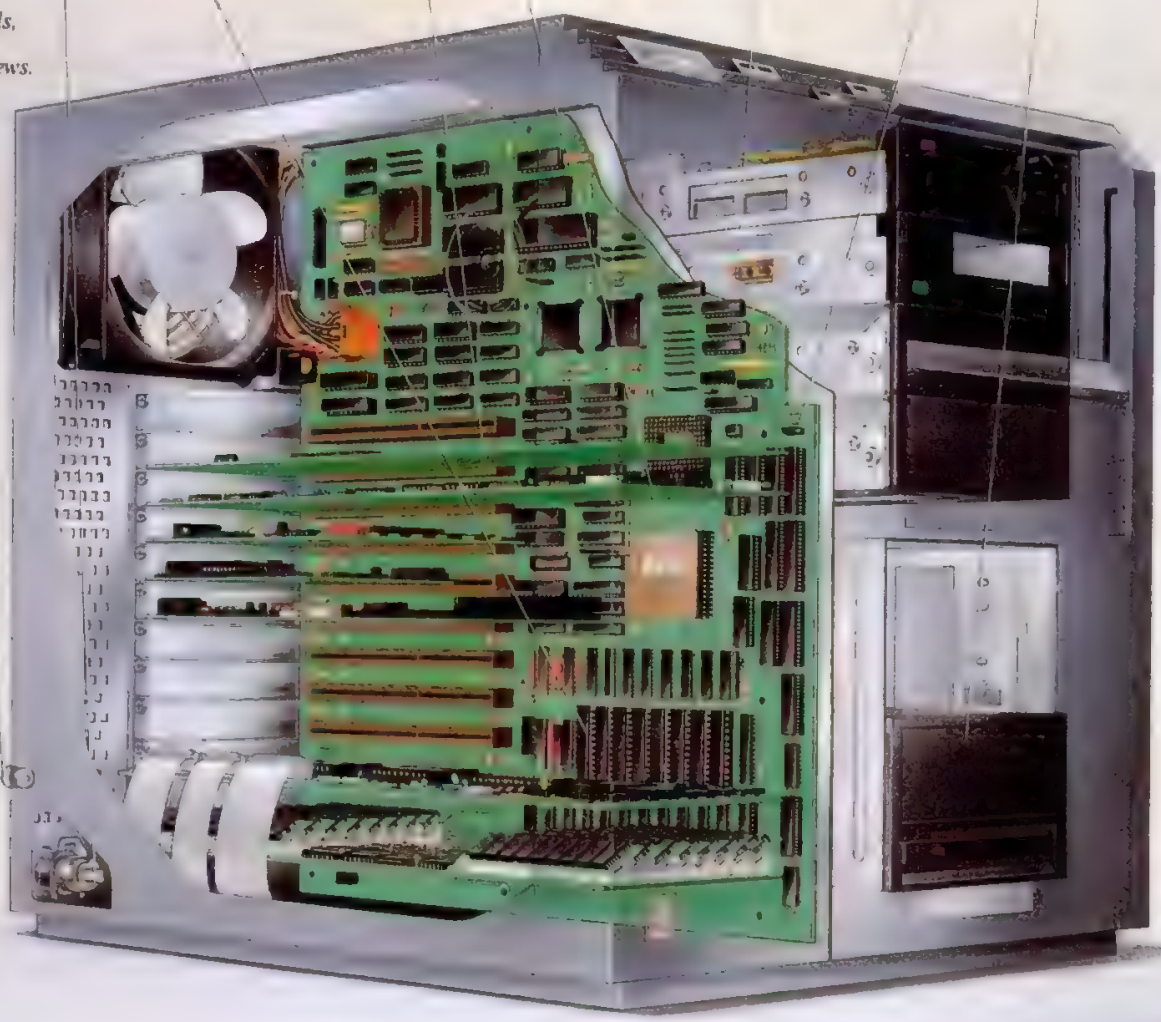
AMMA, a 256KB write-back caching architecture, forming "two-tier" caching in combination with the 486 chip's 8KB internal cache. It improves the cache hit ratio from 90% to as much as 99%.

Space for four quick release, half-height drives. They're front accessible, behind a hydraulically dampened door—which makes sure your drive heads are reading disks and tapes, not dust, smoke and humidity.

The entire interior of the cube is accessible in seconds through side panels, using thumbscrews.

The 486/33 CPU chip, Intel's hottest. But when hotter chips come around, the cube will be cool enough to handle them. And that includes multiprocessors.

Quick release drive bays accommodate up to four more drives that can be swapped out in less than five minutes.



And this is why.

Conventional system design can't cope anymore. The emerging technology is just too hot for it.

Enter the STEP Megacube.™ Designed from the ground up, the STEP Megacube is a 486™ system unlike any other. It incorporates ideas from the mainframe world, such as its caching architecture and thermal management. And it has performance and features that make it a perfect fileserver. Or a perfect multiuser system. Or a perfect graphics workstation.

A 486/33 CPU combined with Everex's proprietary Advanced Memory Management Architecture (AMMA™) gives it warp speed—20.8 MIPS. Space for eight drives gives it storage that will remind you of the Library of Congress. And twelve expansion slots give it more expandability than you can shake a peripheral at.

And if it happens to be an Everex™ peripheral, you could get a nice performance bonus. Because Everex graphics, networking and controller boards are designed to take full advantage of our STEP™ architecture for even better performance.

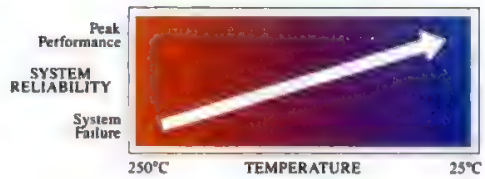
Combine all this with up to 64 MB of RAM—enough for the most demanding applications—and you wind up with a computer that can be configured for anything.

Even the future.

You see, the design breakthroughs of the STEP Megacube eliminate the upgradability problems inherent in other systems. Which means that when the next generation processors arrive—like the 50 MHz 486, just down the road—all you have to do is swap out motherboards. No space problems. No overheating problems.

No obsolescence.

Performance-wise, this is a machine that will be hot long after others are cold and buried. In fact, as of now, there's no end in sight to the STEP Megacube's upgradability path.



The Everex Thermal Management System (ETMS) improves system reliability by reducing internal temperatures.

But really, that shouldn't be much of a surprise. After all, at Everex, our mandate is "Always innovate, never compromise." And that's exactly the approach we took when we built the STEP Megacube.

Granted it doesn't look like your typical 486 system. Fortunately, it doesn't perform like one either. To find out more about what it can do, give us a call.

For a free copy of the STEP Megacube Application Guide, call:

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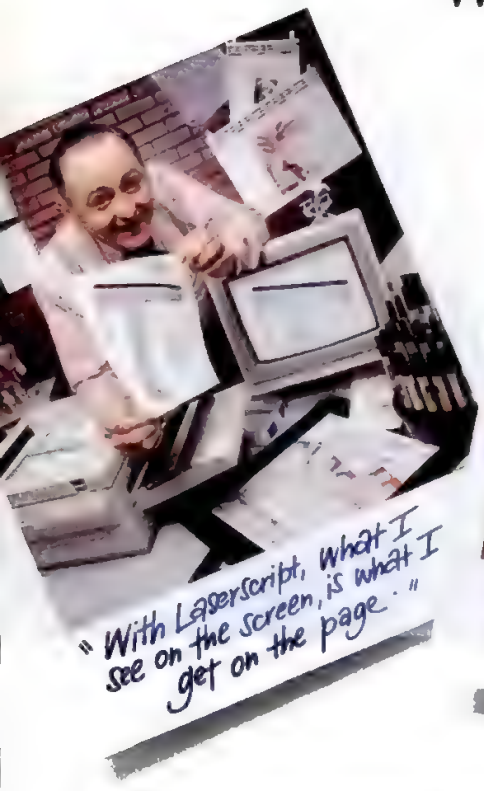
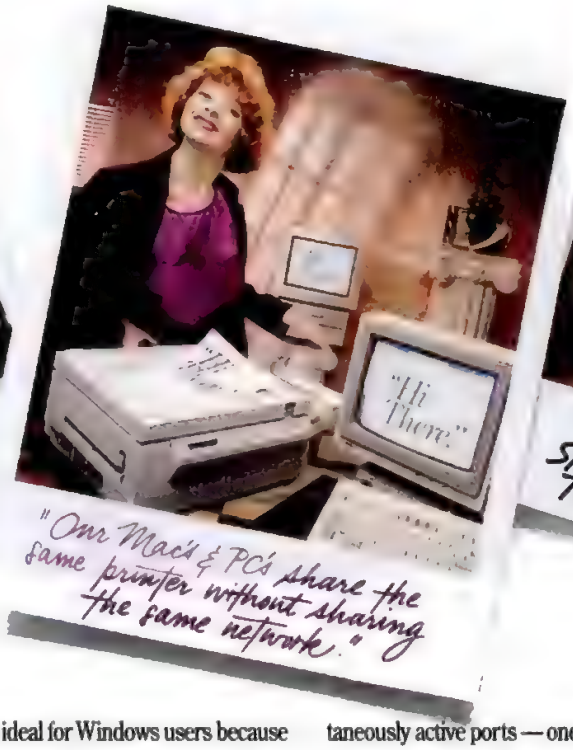
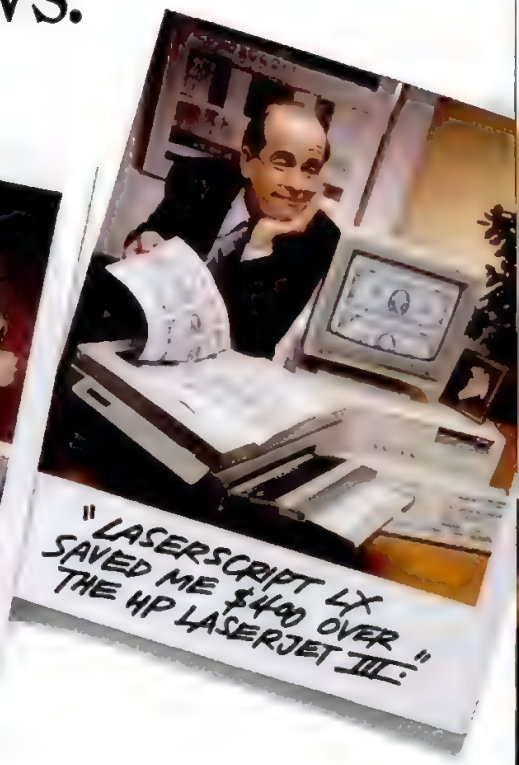
Our PostScript-compatible printer offers big opportunities for people who do Windows.







At $1,995, the Abaton LaserScript LX is ideal for Windows users because its PostScript-compatible language allows you to print exactly what you see on the screen. Whether you're using a PC or a Mac — or both.

Since the PostScript language is device independent, it also works the same for a laser printer, phototypesetter, or slide-capture device. By proofing your work on the LaserScript LX before sending it to a service bureau, you could save the cost of the printer in corrections alone.

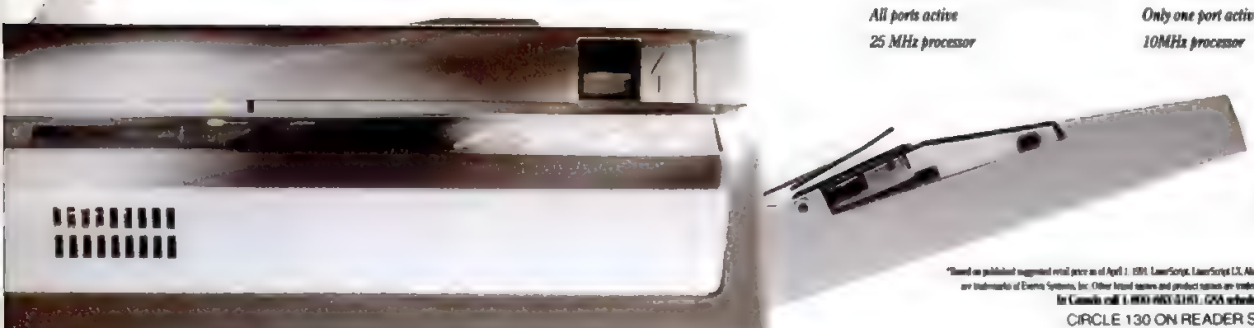
But we didn't stop there. The LaserScript LX is easy to access for both PC and Mac users — *at the same time*. It comes standard with four simultaneously active ports — one LocalTalk, two RS-232, and one Centronics — plus automatic emulation switching, so you can switch between PCL 4 and PostScript-compatible languages.

But the most attractive feature of the LaserScript LX, is that all this performance won't break the bank. In fact, it's priced $400* less than the HP LaserJet III (which doesn't offer PostScript-compatibility). Bottom line, Windows users get more for less with the LaserScript LX.

If you do Windows and want better looking results, call Abaton at 1-800-444-5321 or (415) 683-2226 for the dealer nearest you.

LASERSCRIPT LX
Only $1,995.00

Abaton LaserScript LX $1,995.00*	HP Laserjet III $2,595.00*
PostScript & PCL 4 emulation	*PCL 5*
2.5MB standard RAM	*1MB standard RAM*
Auto-emulation switching	*No emulation switching*
35 resident PostScript fonts/24 bitmapped	*8 resident scalable fonts/14 bitmapped*
1 LocalTalk, 2 RS-232, 1 Centronics port	*1 RS-232, 1 Centronics port*
All ports active	*Only one port active at a time*
25 MHz processor	*10MHz processor*



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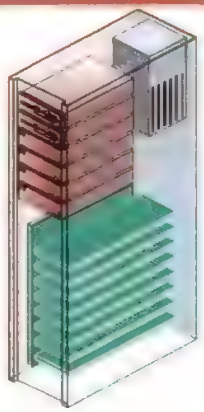


ACMA 486/25E Engineering Workstation
ACMA Computers Inc., 117 Fourier Ave., Fremont, CA 94539; 800-456-1818, 415-623-1212.
List price (tested configuration): $6,595.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.
Disk drives and controller: Maxtor 16-ms. 342MB ESDI; UltraStor controller, 512K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Seiko 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

CIRCLE 388 ON READER SERVICE CARD

hard disk, both a 1.2MB and a 1.44MB floppy disk drive, a 1,024- by 768-pixel noninterlaced video adapter (with 1MB video RAM), and a color monitor. The ISA system that ACMA sent for testing had a NEC 157MB ESDI hard disk with a floppy/hard disk controller. With the same RAM, floppy disk drives, and video subsystem in its standard configuration, ACMA's 486/25E Engineering Workstation costs $6,595, but it comes in a tower case with a 512K caching hard disk controller and a 342MB hard disk rated at 16 milliseconds. Each computer gives you a lot for your money.

THE ISA STANDARD

ACMA's 25-MHz 486 ISA uses a motherboard manufactured by FTC with an Intel chip set and AMI BIOS. All conventional RAM fits on the motherboard to a maximum of 16MB using 70-nanosecond 1MB SIMMs. Like its EISA counterpart, ACMA's ISA system has a 256K external direct-mapped, buffered write-through cache in addition to the 486's internal processor RAM cache.

System expansion options for memory, cards, and drives on this machine are about average for ISA desktop computers. The 486/25I's eight 16-bit ISA interface expansion slots all accept full-length cards. Five slots were free on the machine we tested. The 486/25I's desktop case has room for five half-height drives, three of which can use removable media.

The 486/25I's FTC motherboard with 256K external processor RAM cache helped it (and five others in this group) get the fastest score on the 80486 Instruction Mix test. Disk benchmark test scores were about average for systems with noncached controllers. The motherboard's design hampered the video times a bit compared with the EISA version of this system, but the Orchid ProDesigner II video adapter still attained above-average video scores in our benchmark tests. A 14-inch Seiko 1450C monitor allows true noninterlaced 1,024- by 768-pixel display.

The 486/25I's price compares well with prices for similarly configured systems from other vendors and also gives you a clear basis for decision when compared with 386/33 and 486/33 ISA systems from ACMA. If you don't want the 486's internal processor RAM cache and built-in math coprocessor, you can go with an ACMA 386/33 for $600 less than the 486/25I. If, however, you want 486 performance as well as the fastest processor currently on the market, the price bump to a 33-MHz 486 is an extra $700. For that $700, however, you'll get about a 25 percent gain in processor performance. Your budget and your need for speed will be the main determining factors.

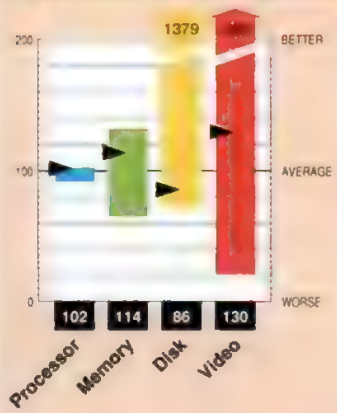
THE EISA ALTERNATIVE

ACMA's EISA system is similar to its ISA sibling in that it has an FTC motherboard with an Intel chip set, 70-nanosecond 1MB SIMMs, and a 256K external RAM cache. One minor difference is that the 486/25E takes Award BIOS chips. Of more significance for some users, the 486/25E can support up to 64MB of RAM on the motherboard with 4MB SIMMs in the 16 SIMM module slots.

The 486/25E EISA has two 16-bit ISA slots and six 32-bit EISA bus slots; four slots were free in our test system. The slots in use were taken up by video, I/O, floppy disk controller, and hard disk controller boards. Although using separate drive controllers costs an expansion slot, four free slots with none needed for

ACMA 486/25I

TEST RESULTS



In Short: Both ACMA 486/25s offer better-than-average performance with good system expansion space at competitive prices. The ISA-bus ACMA 486/25I has five free slots in its standard configuration and room for five half-height drives. With its 256K external RAM cache, the 486/25I had the fastest processor test score (tied with five other 486/25s), average or above-average scores on the memory and video tests, and a competitive disk score among noncached machines.

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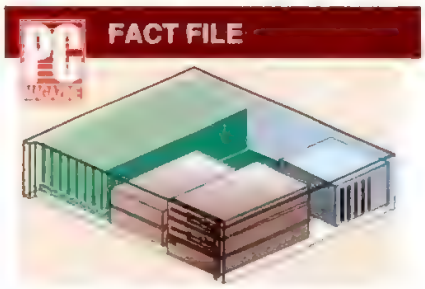


ACMA 486/25I Engineering Workstation
ACMA Computers Inc., 117 Fourier Ave., Fremont, CA 94539; 800-456-1818, 415-623-1212.
List price (tested configuration): $4,195.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.
Disk drives and controller: NEC 18-ms. 157MB ESDI hard disk, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Seiko 14-inch monitor.
Software: DOS 4.01.

CIRCLE 389 ON READER SERVICE CARD

memory expansion should be sufficient for most workstation uses.

The 486/25E's tower case has more space and better versatility than the 486/25I's desktop case. It can hold six half-height drives that can accept removable media.

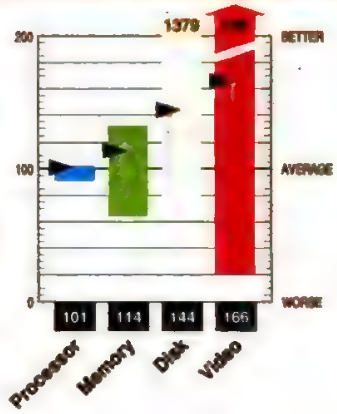
When it comes to performance, ACMA's EISA system compares well on the PC Magazine Labs benchmark tests—both against other vendors' EISA computers and against ACMA's own ISA system. The EISA machine did well in every test category, scoring above average on our disk and video tests. On the DOS File Access test, moreover, the 486/25E got a boost from the 512K cache on its UltraStor ESDI hard disk controller.

The 486/25E's price compares well against similarly equipped EISA systems from other vendors. If you need the best performance possible, however, you can spend an additional $800 for ACMA's 33-MHz EISA. This is enough of a price jump to make you pause, but a 25 percent faster processor for a 12 percent system price increase may be a favorable incentive for power hounds.

The difference in price between EISA and ISA gives you more reason to pause. When you equalize the prices for the larger drive, caching controller, and tower case, the EISA system we tested still costs over $1,000 more than a comparable ISA system. Sure you can put up to 64MB in the 486/25E, and it did get somewhat better drive and video times than the 486/25I. But unless you know you'll need the extra-fast data transfer times possible with

ACMA 486/25E

TEST RESULTS



In Short: The EISA-bus ACMA 486/25E, with a 512K cache on its UltraStor disk controller and a 1MB Orchid ProDesigner II video board, had better-than-average scores on our disk and video tests. The caching EISA disk controller was primarily responsible for a large difference in scores between ACMA's ISA and EISA computers. The EISA system comes in a tower case with four open expansion slots and six half-height drive bays, all capable of using removable media.

Advanced Printer Sharing at Half the Cost.

With SmartPrint, it's as though each computer has its own printer. SmartPrint allows several computers to share any printer automatically. It operates transparently, so you work exactly as before.

While other printer sharing devices use expensive yet limited RAM buffers, SmartPrint lets you work smarter by using advanced spooler software that buffers work to your hard disk, eliminating the chance of lost data or system hang-ups.

And, our advanced circuitry allows extra long cable lengths from each computer (up to 50 ft. parallel, 1,000 ft. serial).

SmartPrint is a snap to install, too. Just connect your computers and printer to SmartPrint using standard cables and you're ready to go. That's all there is to it. And SmartPrint is Hewlett-Packard and FCC approved.

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Smart technology. Smart Price. It's called SmartPrint.

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PSS-P6	6	Parallel	$229
PSS-S4	4	Serial	$199
PSS-S6	6	Serial	$229

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Model	Computers	Printers	Price
MP5	1Par/1Ser	4Par/1Ser	$249

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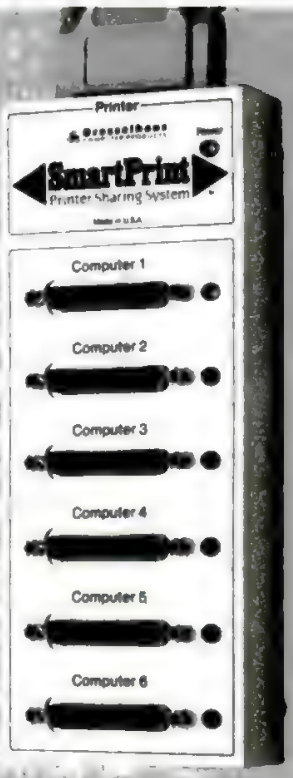
Rancho Cucamonga, CA 91730
(714) 945-5600/FAX: (714) 989-2436



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SmartPrint is distributed by **Ingram Micro D** and can be found or ordered at most computer stores, including **Computerland, CompuCom, Connecting Point, Egghead, Entre, 47th Street Computer, Inacomp, Jade, Microage, PC Warehouse** and **Softwarehouse.** Call 1-800-368-7737 for the store nearest you.

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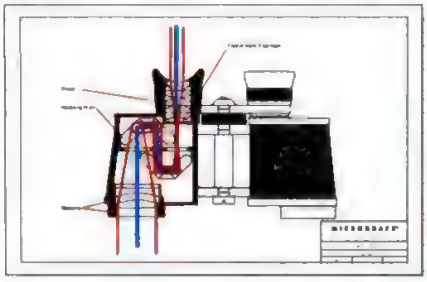

▲ *Higher performance in Designer 3.1 speeds up drawings with faster wide styled lines–even wide dashed lines. Object snap points make precision a given.*

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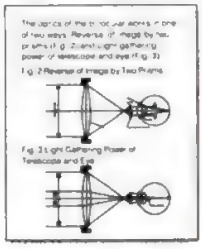

Outside perspective reflects well. "Designer is an outstanding illustration package that receives Editor's Choice recognition. Designer is perhaps the most sophisticated of all the illustration packages," writes *PC Magazine.*

Software Digest reports that "Designer provides the best overall graphics package. The program offers state-of-the-art features, good performance, and unmatched ease of learning and use in a sophisticated package. Designer can handle virtually any free-form graphics or design task with ease." Designer was awarded a top-of-the-class rating.

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the EISA bus—or want to be ready for other yet-to-surface interface cards that can use the EISA's potential—you should probably stick with the ISA machine.

SUPERLATIVE SERVICE

ACMA is strictly a mail- and telephone-order sales organization. To back its sales effort, ACMA has a superlative set of service and support policies for all its systems. The basic warranty covers parts for one year and labor for two years. You can get telephone service via a toll-free technical support line as well as parts shipping if you wish, but a one-year on-site service contract with TRW is standard. ACMA also offers a 45-day money-back satisfaction guarantee, standard.

Both ACMA systems are recommended. They come from a known, proven vendor with a good service record and generous support policies, have better-than-average overall performance, and roomy, if not capacious, expansion capabilities. The ACMA EISA and ISA prices also compare well with their respective competitors from other vendors. The only decision you have to make is whether the promise of the EISA box is worth approximately $1,000 more than what the ISA system can deliver now.

ADVANCED LOGIC RESEARCH INC.

ALR BusinessVEISA

by Rink Murray

The ALR BusinessVEISA's modular CPU gives users the ability to upgrade their systems to faster processors. In this regard the BusinessVEISA promises to deliver a long computing life. There's only one catch: This computer with a built-in upgrade path is not cheap, and upgrades themselves will cost you a bundle, too.

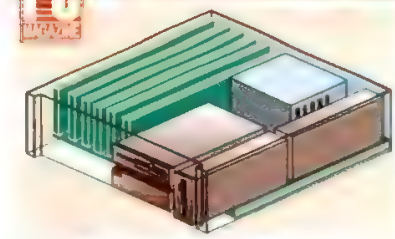
Our $9,699 ALR test unit arrived with 9MB RAM, which consisted of 1MB of 80-nanosecond RAM soldered onto the motherboard and 8MB of 80-ns. SIMMs on the motherboard's RAM bank. The RAM bank must be filled with some combination of 256K, 1MB, or 4MB SIMMs.

Also included in our tested system was a pleasantly quiet 16-millisecond Seagate 330MB ESDI hard disk, a bus-mastering 32-bit ALR 1090V hard disk controller, a 1.2MB floppy disk drive, three ports (one serial, one parallel, and one mouse), and ALR's FlexVIEW 2x VGA display, ALR's 16-bit Super VGA card with 256K RAM, and DOS 4.01.

COMPUTERS

25-MHz 486 PCs

FACT FILE



ALR BusinessVEISA
Advanced Logic Research Inc., 9401 Jeronimo, Irvine, CA 92718; 800-444-4ALR, 714-581-6770.
List price (tested configuration): $9,699.
Memory and processor RAM cache: 9MB 80-ns. SIMMs.
Disk drives and controller: Seagate 16-ms. 330MB ESDI; UltraStor controller, 512K cache; 1.2MB floppy disk drive.
Display: ALR 256K Super VGA adapter, ALR 14-inch monitor.
Software: DOS 4.01.

CIRCLE 401 ON READER SERVICE CARD

MIDDLE OF THE PACK

Although the BusinessVEISA's price was high, its performance on the processor and memory tests was average relative to that of our test group. The BusinessVEISA should show minor performance gains if you're willing to fork over another $600 for ALR's external 64K CachePAK option. Chances are, the performance difference wouldn't be enough to make the investment pay off.

ALR's Super VGA card was a disappointment on our video test suite, landing third from the bottom. However, when using the 512K cache on the ALR-labeled Western Digital disk controller, this system climbed into the top quarter in our disk tests—a feat that looks impressive in this context but is less so when compared with other systems that have caching hard disk controllers.

If more speed is essential, you can opt for the 486/33 processor for an additional $300. To use this system as a server, ALR recommends installing the CachePAK and one of its faster hard disk controllers. Expect to pay $500 to $700 more for the faster controller.

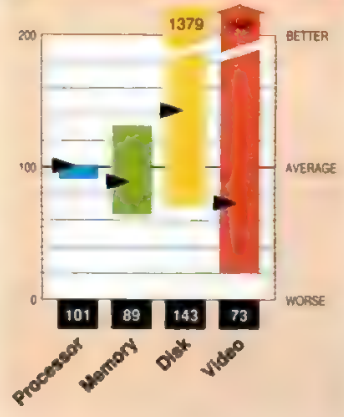
WORKSTATION DELUXE

Otherwise, the BusinessVEISA seems perfectly suited as a powerhouse workstation. Measuring 6 by 15 by 17 inches (HWD), this small-footprint PC holds up to 17MB RAM on the motherboard. To install more than 17MB, you must purchase ALR's proprietary memory module, which costs $199 with no RAM installed. The BusinessVEISA also has two half-height drive bays: one external 3.5-inch drive bay and one internal one.

The BusinessVEISA has three 32-bit EISA slots, two 16-bit ISA slots, and three proprietary ALR slots for a memory card, cache card, and the CPU module. In our test unit, one 16-bit slot was occupied by

ALR BUSINESSVEISA

TEST RESULTS



In Short: The ALR BusinessVEISA's performance is irregular. While its processor and memory test scores were average, the system's Seagate ESDI hard disk and 512K cached controller performed very well, while the Western Digital VGA card turned in a score that was visibly worse than average. At $9,669, this system may seem expensive, but it allows users to upgrade to faster CPUs and to take advantage of EISA compatibility. Even with ALR's buy-back plan, however, upgrades will not be cheap.

the Super VGA card, and a 32-bit slot held the hard disk controller. In addition to the CPU's built-in 80387 coprocessor, CAD users will welcome the slot for the Weitek 4167 coprocessor. ALR built the system's internals with exemplary care. The motherboard is compact yet orderly, with every chip and slot easy to reach.

STRIPPED SCREWS

The chassis, however, looked like it had been designed for another model. The screws that held the cover to the chassis were about three times as long as standard screws and wider too. By the time we had opened and closed the machine several times, the screws were almost stripped. Unless we tightened the screws all the way, the machine would not turn on. This happened because the power switch, a push-button device, was located on the front panel of the PC's removable cover. If we didn't have the cover screwed on very tightly, the switch wouldn't connect. ALR says these problems were unique to the model we tested and assured us that the BusinessVEISAs now shipping do not—and never have had—this problem.

The ALR BusinessVEISA ships with a one-year warranty for parts and labor. All service is handled through ALR dealers or through on-site service from TRW. This is a fairly standard service policy among the vendors in this overview.

CPU-ON-A-CARD

If the time comes when you want to upgrade your CPU, ALR does offer a CPU card buy-back plan. Although the company plans to offer 50-MHz 486 CPU upgrades when the chip becomes available, the only current upgrade is to a 33-MHz 486.

Considering that ALR will give you $700 for your old 486/25 processor and that the current cost of its 486/33 is $2,695, the prudent shopper will consider purchasing the 486/33 version first. It will cost you only $300 more than the 25-MHz BusinessVEISA, and you'll avoid the paperwork and upgrade agony.

Although the cost is high, the ALR BusinessVEISA does allow you to upgrade your processor, which may suit those who want 486 computing now on the EISA platform. But if you're going to spend this kind of money, you may as well spend relatively little more for the fastest processor currently available and bide your time until Intel starts numbering its CPUs with a "5."

AGI COMPUTER INC.

AGI 4100A

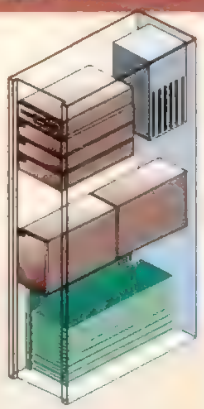
by John R. Quain

If you can't beat 'em, sell the same product. That seems to be the maxim that AGI Computer has followed for its 4100A, a 25-MHz ISA. For all intents and purposes, the AGI 4100A is an Everex system: It has an Everex motherboard, Everex monitor, Everex 16-bit video card, and an Everex ESDI hard disk controller.

The second business maxim that AGI seems to have adopted is if you can't offer something different, beat the other company's price. AGI's 4100A undercuts the price of the similar Everex Step 486/25 by about $3,500, although the Everex system boasts a larger hard disk. Nevertheless, unless you can get a substantial dealer discount, the AGI's $6,995 price tag may still be too high for it to remain competitive in this group, especially considering the 4100A's less than stellar performance on our benchmark tests.

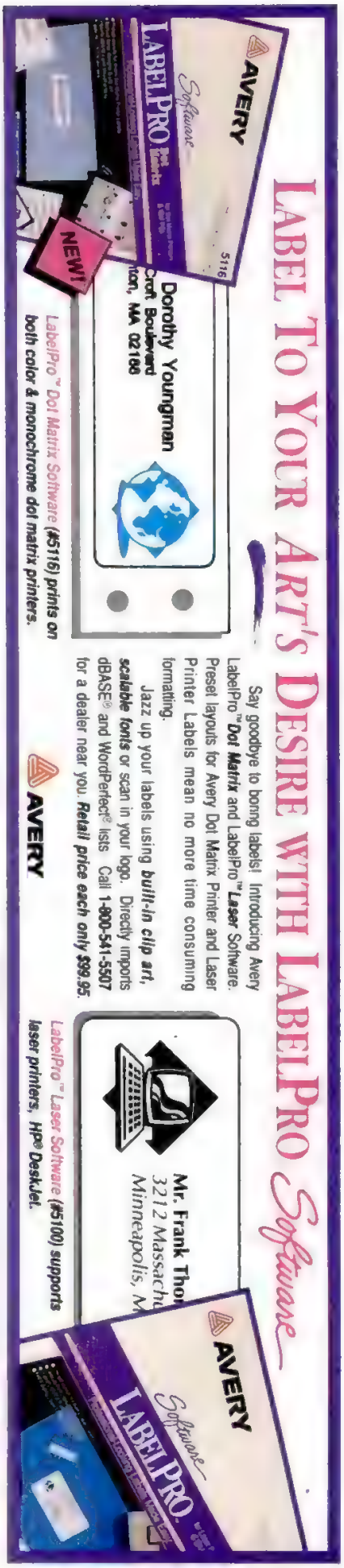
For your $6,995 you get familiar names: AMI BIOS, a discrete logic chip set, 280MB Maxtor hard disk, 1.2MB TEAC floppy disk drive, and DOS 4.01—no strays or unknowns here. You also get expandability in the form of room for an additional internal full-height drive and three accessible half-height bays. If you plan to fill up the expansion slots and turn the 4100A into a file server, there are three 16-bit slots, one proprietary slot (for 32-

FACT FILE

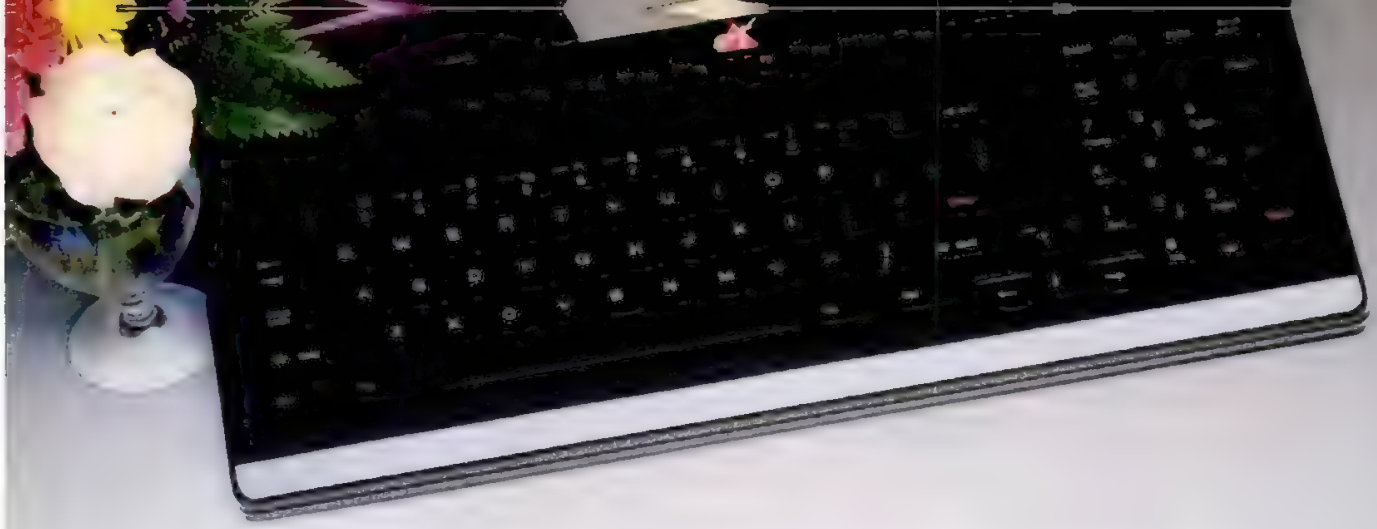


AGI 4100A
AGI Computer Inc., 48431 Milmont Dr., Fremont, CA 94538; 415-683-2200.
List price (tested configuration): $6,995
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Maxtor 16-ms. 280MB ESDI, Everex controller, 1.2MB floppy disk drive.
Display: Everex 512K Super VGA adapter, Everex 14-inch monitor.
Software: DOS 4.01.

CIRCLE 409 ON READER SERVICE CARD



CIRCLE 129 ON READER SERVICE CARD



POPULAR PRAISE FOR THE PORTABLE DESKTOP

This new generation PC is remarkable for the performance and practicality it provides. Carry it from the office, to home, to multi-site locations so all your programs and files travel conveniently with you.

Customers and critics alike are praising the Brick for its portability, elegant design, whisper quiet operation and screamingly fast power. This diminutive PC with the unforgettable name is designed for the way you always wanted to do computing.

Here's a sampling from recent articles on the Brick.

"Every once in a while a PC product comes along in which the performance, design and concept are so uncommon that a little voice inside you says you really want to have one."

Jon Pepper,
PC Sources, *11/90*

"Engineered with the way people actually work in mind. It answers the question of how to transport an entire environment to and from several work sites, something no other product handles elegantly."

PC/Computing, *12/90*

"Overall the Brick represents a clever counter to conventional notebook designs. It solves the fundamental problem of two-location computing. You get to keep your home and away files in sync because they are the same."

Tracy Licklider
BCS UPDATE, *7/90*

"Ergo's Brick maintains the functionality of a desktop PC within a small form-factor...the Brick is a real performer, consistently outperforming both Compaq's and IBM's 16 MHz SXs on PC Labs computer benchmark tests."

Matt Ross,
PC Magazine, *9/25/90*

"The Ergo Brick—that delightfully small, full-featured 386SX™ machine. It's almost silent, it's fast... a great personal computer in every other respect too."

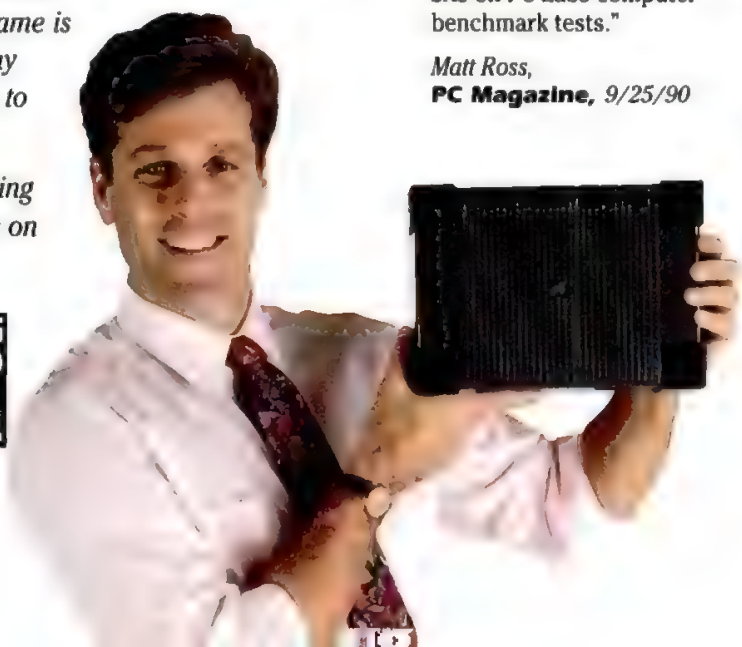
Bill Machrone,
PC Magazine, *1/15/91*

"The Brick is the first real innovation in DOS based computers in a long, long time."

Computer Shopper, *1/91*

"The philosophy behind the Brick is so obvious that I'm surprised that no one has thought of it before...you can keep a monitor and a keyboard at each work location, carrying only the computer guts (and your own data) between locations...in a world of boring and utilitarian PCs, the Brick stands out for both its elegance and its technological sophistication."

Stan Miastkowski,
BYTE, *6/90*



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Jon Pepper,
PC Sources, *11/90*

"An ideal system for those who split their working time between home and office...The stylish "black granite" and beige cases look as if they came straight from the pages of a Sharper Image catalog."

PC Week, *9/24/90*

"The Brick is first class all the way. Its appearance and feel suggest even higher quality than that of the Toshiba and Compaq... This system provides an amazing amount of features and support for the price."

Peter Varhol,
Personal Workstation *11/90*

Hi-res video drivers are included for over 25 major applications including Windows 3.0, WordPerfect, Ventura, Autocad, Cadkey, and Lotus. The Docking Terminal ($349) permits instant hook-up of all cables and adds another 16-bit 3/4 length slot.

"...everyone who sees it falls in love with it... Recommended."

Jerry Pournelle,
BYTE, *1/91*

"Using the Brick is a pleasure. In fact, several things about the Brick are terrific. By any standard it's a well equipped and competitively priced 386SX desktop; when you add the appeal of its diminutive size, it becomes adorable."

Eric Grevstad,
Portable Office, *12/90*

"The beauty of this arrangement is that you never have to worry about the consistency of your data files... you just take it all with you."

Henry Fersko-Weiss,
PC Magazine, *3/91*

"Only slightly larger and heavier than a college dictionary, the Brick is a faux-granite-finished portable CPU that explores the middle ground between desktop PCs and portable computers."

Fred Paul,
PC/Computing, *8/90*

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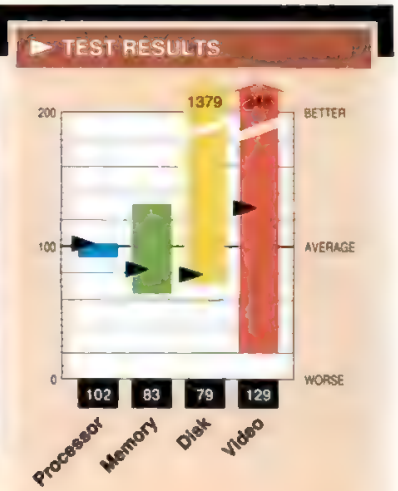
CIRCLE 241 ON READER SERVICE CARD

AGI 4100A



In Short: The 256K of 20-ns. SRAM helped the AGI 4100A achieve solid above-average processor performance, but its memory test score did not match the competition, primarily because of the machine's 80-ns. RAM and page-mode addressing. The Everex ESDI disk controller did poorly on our test. The tower case, stacked with components from Everex and other familiar names, spells reliability. But for this ISA system to remain competitive, its price will have to come down.

bit memory cards or 8-bit ISA), and a single 8-bit slot still free after the requisite video, disk controller, and I/O cards are installed. Moreover, you should feel confident about the sturdy tower case, which houses two fans, top and bottom, for plenty of ventilation.

Our system came with 8MB of 1MB 80-nanosecond SIMMs on the motherboard. For memory hogs, there's room for 16MB of SIMM RAM, though you'll have to remove the Maxtor drive if you want to add to or change your machine's RAM configuration. The AGI owner's manual is a veritable godsend in this regard. In a forest of clone manufacturers that simply throw the original components' technical documentation into the shipping box, AGI includes a finished system manual that tells the average user in diagrammatic detail just how to perform such tasks as removing the hard disk.

In processor tests, the 256K of 20-ns. external RAM cache helped the 4100A achieve the top score (along with six other systems) on the Instruction Mix test. On the other hand, conventional memory scores did not match those of the competition: Only one other system's memory was slower. This lag was primarily the result of AGI's 80-ns. RAM and its page-mode addressing scheme, compared with the faster 70-ns. RAM and interleaved page-mode arrangements of the others.

LAN managers will not be much happier with the AGI's hard disk benchmark test scores. The ESDI floppy/hard disk controller, which can handle a total of two floppy and two hard disks, did poorly on our tests. Once again, only one other system was slower. You'll need disk caching software to achieve better speed results.

If you're considering this machine for heavy design work, note that the top-of-the-line Everex Viewpoint VRAM SuperVGA video adapter didn't raise much applause, either: It landed smack in the middle of the pack.

AGI doesn't offer a 33-MHz 486, but according to the company, a similarly configured 386/33 costs $1,000 dollars less than the 4100A. Typically, 25-MHz 486s offer a 10 to 15 percent performance boost over 33-MHz 386s. Assuming that this holds true in AGI's case, you'll have to consider other possible benefits, such as the computer's ability to use a Weitek 4167 coprocessor, to justify the 25 percent price for the 486.

AGI's PCs are approved for FCC Class B certification—good news for those who need a 486 in the home—and are sold primarily through distributors. The company offers a one-year parts and labor warranty which is also fulfilled through its dealers.

If you must have a 25-MHz 486 PC, the AGI 4100A offers reliable components, although neither its price nor its performance is very competitive.

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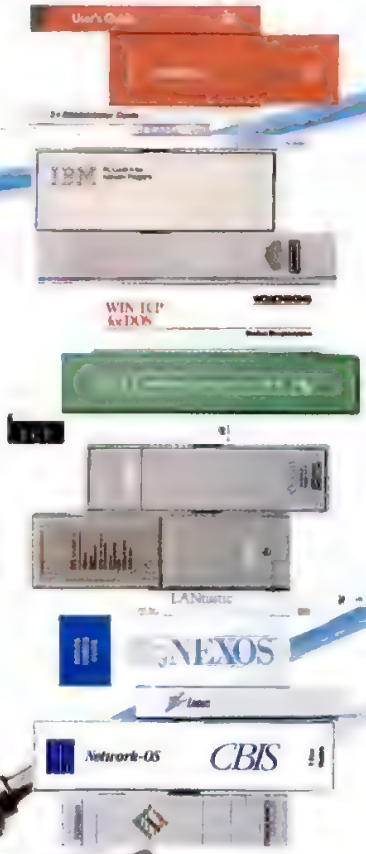

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LAN Manager	●	▲	
Banyan Vines	▲	▲	●
FTP Software PC/TCP	▲	▲	
Wollongong WIN/TCP	●	▲	
10SET TCP/IP		▲	
NCSA TCP/IP		▲	
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Amax 486 EISAmax

by M. David Stone

Housed in a 7.5-inch-wide tower case with six accessible, half-height drive bays, Amax Engineering Corp.'s 486 EISAmax is clearly intended to be equally at home as a network server or as a heavy-duty workstation for desktop publishing or CAD applications. More important, it's worth considering in either role. Its performance on our PC Magazine Labs tests ranged from average to excellent at a price that's lower than average for EISA systems.

Amax's price for the standard configuration specified by *PC Magazine* is $6,910. This gives you 8MB RAM, a 256K processor RAM cache, a 1.2MB or 1.44MB floppy disk drive, a 210MB hard disk, and an 800- by 600-pixel Super VGA card with a NEC 2A monitor. As tested, the system included a second floppy disk drive, a 1,024- by 768-pixel noninterlaced video card, and a NEC 3D monitor for a total price of $7,210. The system we tested, with a 330MB hard disk, can be had for $7,639.

The tower case follows a more intelligent design than most, with the six half-height bays in a single stack starting at the top of the tower. This arrangement gives maximum flexibility for adding any combination of drives in various sizes and does not cover the motherboard with drive bays. The result is that the motherboard is completely accessible. And you'll have no trouble getting at the 16 SIMM sockets or the Weitek coprocessor socket.

The Free Technology motherboard, which in this system is OEM'd under the Helm Engineering name, incorporates all the crucial motherboard components including the Intel chip set, Award BIOS, 25-MHz 80486 processor, and 256K of 25-nanosecond cache RAM. All system RAM goes into the SIMM sockets, which accept either 1MB or 4MB modules for a total of 64MB. As tested, the unit came with eight 1MB SIMMs.

The eight slots on the motherboard consist of two 16-bit ISA slots and six 32-bit EISAs. The two 16-bit slots shouldn't be an issue, however, since you're likely to be using more 8-bit and 16-bit boards than EISA boards for some time to come.

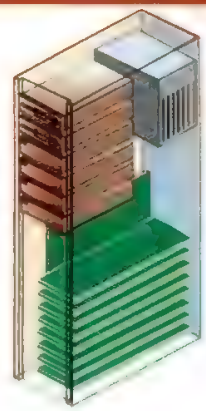
The lack of a wide choice of EISA boards is a problem that the 486 EISAmax shares with other EISA machines. The only EISA card in the review unit was the UltraStor Ultra-22C ESDI EISA bus master card that showed up in other EISA systems as well. The Ultra-22C, with its minimum 512K intelligent cache, yielded good performance in our tests in combination with the 15-millisecond Maxtor drive. Unfortunately, the card lacks support for a floppy disk drive, so you'll have to use a second slot for a floppy disk controller.

Three other slots in the test system were occupied by the Orchid ProDesigner II board, the parallel/serial board, and the additional communications and game port connected to the parallel/serial card. You can regain one slot by fitting connectors into the cutouts on the tower's back panel instead of using a slot. But that still leaves only four slots free.

If you're not committed to the EISA bus, note that Amax also offers two 486-based ISAs: a 486/25 (reviewed in "The First 24 486/25 PCs," *PC Magazine*, September 11, 1990, page 101) and a 486/33. Equipped identically to its 486/25 EISA, Amax's 486/25 ISA is just $4,595—a savings of $2,700 over the EISA. And at $5,445, Amax's 486/33 ISA represents a significant saving over its 486/25 EISA. The company's 486/33 EISA costs $7,995 for the same configuration—roughly a 10 percent premium for a 25 percent faster processor.

Amax's warranty and support policies are one notch beyond minimal. The unit includes the usual one-year warranty, with service provided by dealers. There is a toll-free technical support number and a $99-per-year optional service contract with Memorex-Telex. All told, thanks to the combination of relatively low price, good overall performance, and six drive bays that leave plenty of room for expansion, the Amax 486 EISAmax is a better-than-average value among EISA systems. And keep in mind that the $7,639 for the system as tested is a suggested list price. The street price could be 20 percent lower, making it an even better value.

FACT FILE

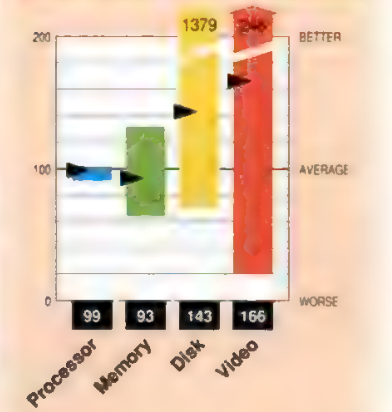


Amax 486 EISAmax
Amax Engineering Corp., 47315 Mission Falls Ct., Fremont, CA 94539; 800-888-2629, 415-651-8886.
List price (tested configuration): $7,639.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.
Disk drives and controller: Maxtor 15-ms. 330MB ESDI; UltraStor controller, 512K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, NEC 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

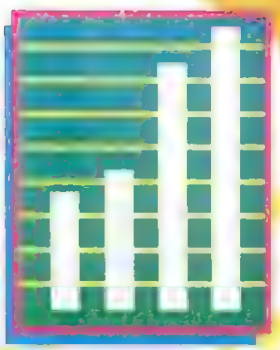
CIRCLE 402 ON READER SERVICE CARD

AMAX 486 EISAMAX

TEST RESULTS



In Short: The Amax 486 EISAmax achieved test scores ranging from average to excellent. This system made good use of the Orchid ProDesigner II video card. Similarly, the combination of a 15-ms. Maxtor hard disk with 512K disk cache yielded very good performance, alongside other systems with caching controllers. The 486 EISAmax offers a tower case with six drive bays and the usual eight system slots. All this, combined with a low price, makes the 486 EISAmax a strong competitor.



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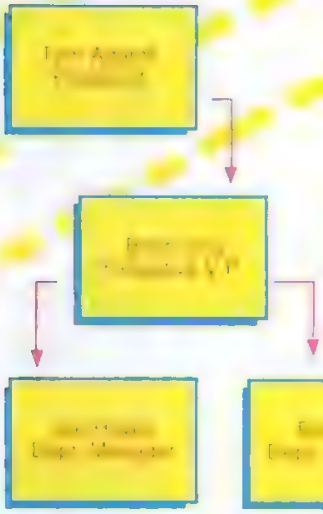

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CIRCLE 477 ON READER SERVICE CARD

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AMERICAN RESEARCH CORP.

ARC Skyscraper 486/25c

by Henry Fersko-Weiss

The Skyscraper 486/25C is ARC's first foray into the 486 marketplace with a computer under its own name. This ISA bus tower computer is solidly constructed, and its narrow profile has ample room for expansion. Although the Skyscraper's performance was average on PC Magazine Labs' benchmark tests, it boasts a lower-than-average price.

In the configuration we tested—8MB RAM, 128K processor RAM cache, 183MB hard disk, a 1.2MB and a 1.44MB floppy disk drive, 1,024- by 768-pixel display system, mouse, *Windows* 3.0 and DOS 4.01—the Skyscraper 486/25c costs $3,595. With only one floppy disk drive (to meet *PC Magazine*'s standard configuration), you'll pay $80 less. You can also purchase a basic system with the same amount of RAM, a 64K processor RAM cache, an 89MB hard disk, one floppy disk drive, and a Super VGA card for only $375 less than the standard configuration described above.

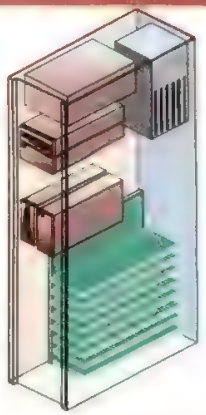
In any case, you had better like the standard configuration of this computer because ARC offers very few options. Beside the hard disks in the basic and standard configurations, you can choose between a 144MB and 300MB SCSI drive. If you want an internal tape drive, however, or a different monitor or video card, you'll have to look to other suppliers because ARC doesn't sell them. And the only extra software you can buy from ARC is OS/2 1.1.

NARROW CASE

One of the distinctive features of the Skyscraper is its narrow case. The company gets this profile by turning the two accessible half-height, 5.25-inch drive bays sideways; above them are two 3.5-inch bays. A full-height, 5.25-inch drive bay is inside, but because of the way it's suspended from the top of the machine, you can't fit two half-height drives there.

The computer's all-metal case is very solid; only the face plate is made of plastic. The removable side panel has overlapping flanges that seal the seams very tightly. ARC targets the Skyscraper at medium-to-large businesses for use as a file server or engineering workstation.

FACT FILE



ARC Skyscraper 486/25c
American Research Corp., 1101 Monterey Pass Rd., Monterey Park, CA 91754; 800-346-3272, 213-265-0835.
List price (tested configuration): $3,595.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Seagate 18-ms. 183MB SCSI, Adaptec controller, 1.2MB and 1.44MB floppy disk drives.
Display: Mentor 1,024 by 768 adapter with 1MB RAM, Tatung 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0 with mouse.

CIRCLE 403 ON READER SERVICE CARD

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Parana's product quality earned the EPSON APPROVED endorsement for Epson ribbon replacement. Whether you're using Windows 3.0 or Macintosh, or printing charts from Lotus 1-2-3, a Parana ribbon will enhance your image. Call **1-800-4PARANA** for the name of your nearest Parana dealer.

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For mission critical networking, you need the PC servers rated Number One.

In Computerworld's Buyers' Scorecard, HP Vectra PCs rated highest in overall satisfaction.[1] When PC Magazine polled 20,000 readers, they put HP personal computers at the very top of the list for reliability.[2]

In fact, our PCs are so reliable that we now give a 1-year on-site limited warranty on our 486 PCs.[3] And our hard disks have a 17-year MTBF—three times the industry average.

We have 25 years' experience in building and supporting computer networks. So you can count on HP to understand your needs and provide precisely the right solution for them.

Of course, our line of PCs is fully compatible with industry standards, including network operating systems such as Novell NetWare, LAN Manager and 3+Open.

So, if PC networking is critical to your business, call **1-800-752-0900, Ext. 1996** for more information and your nearest HP dealer.

SEE US AT COMDEX BOOTH #1252

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[1]Computerworld, 11/2/90. [2]PC Magazine, 9/25/90. [3]Warranty applies to HP Vectra 486/25T and 486/33T PCs. Warranty offer available only in U.S. and Canada. © 1991 Hewlett-Packard Company CPPC012

25-MHz 486-BASED PCs: SUMMARY OF FEATURES

List price (standard configuration) For this review of 25-MHz 80486 computers, we requested a standard configuration that included 8MB of RAM, a 200MB to 300MB hard disk, one floppy disk drive, a Super VGA color display subsystem, one parallel and two serial ports, and DOS 4.01. All 29 PCs reviewed here provide a reasonably close match to this list of requirements.

The price of the standard configuration is followed by the **standard hard disk capacity.** Unless otherwise noted, all table entries refer to the range of options available in the systems reviewed.

Distribution channel Dealers often offer discounts of 25 percent or more off the list price (although there is no guarantee that the discounts will run this high). Direct mail-order vendors offer no such discounts.

80486 chip set manufacturer indicates which company makes the support logic that connects the CPU with the other functions managed by the system board. In some cases the computer uses discrete logic rather than a chip set.

System RAM arrangement refers to the method in which memory is addressed. Different arrangements aim at avoiding the wait states imposed when CPU speed outpaces conventional memory speed.

Page-mode architecture allows back-to-back memory accesses within banks of RAM defined as pages.

Interleaved RAM arrangement divides memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section undergoes a refresh cycle. Systems may also use interleaving in conjunction with page-mode architecture. We refer to this arrangement as *interleaved page.*

Row/column, the original method of accessing data, is a subset of the page-mode memory architecture.

Installable RAM indicates the minimum and maximum amount of memory that can be installed using any combination of chips and proprietary cards.

The **BIOS version** can affect PC Magazine Labs' benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Setup can reside either on a floppy disk or in the system's ROM.

Shadowing Shadow RAM is a technology that loads video BIOS or system BIOS directly into fast RAM when the computer is booted, offering enhanced performance speed. It uses a segment of system memory located between the boundary of conventional memory (640K) and the end of the first megabyte of installed RAM. With some applications, the ability to disable shadowing is important in resolving memory conflicts.

Hard disk options We report the range of hard disk capacities the vendor offers.

Minimal floppy disk configuration indicates whether the vendor equips its base-priced system with a 1.2MB or a 1.44MB floppy disk drive, or both.

Expansion slots For each type of expansion slot—8-bit, 16-bit, 32-bit EISA/MCA, and 32-bit proprietary—we report the total number of slots on the motherboard and the number of slots left open when the PC is equipped in our standard configuration. The latter appears in parentheses.

Display mode refers to the resolution of the video card that came in the tested configuration. For this review, we requested a Super VGA (800- by 600-pixel resolution) display, though we accepted 1,024-by-768 resolution as well.

The **display circuitry** can reside on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled there is no way to upgrade it.

DOS versions and prices are listed here. If no price is given, the base-priced system includes DOS. (*PC Magazine* 's standard configuration includes DOS 4.01—or 3.3 if 4.01 is not available—to allow more-accurate price comparisons.)

Other software listed is bundled free of charge unless price is given. This category includes disk-caching software (such as SMARTDRV.SYS), expanded memory management software (such as *QEMM*), *Windows* 3.0, and any applications the vendor supplies as extras.

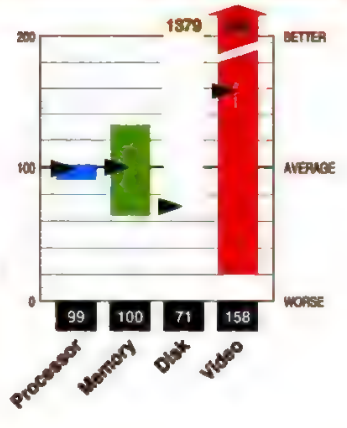
Number of device connectors indicates how many internal storage devices the power supply can support without requiring Y cables (power splitters).

FCC Class B identification number Systems with a Class B rating from the Federal Communications Commission can be purchased for home use. Systems listed as *pending* have been submitted to the FCC for certification. Public Access Link, the FCC's bulletin board service (301-725-1072), lists every Class B and B-pending system by its FCC identification number.

CONTINUES

ARC SKYSCRAPER

TEST RESULTS



In Short: Look to the ARC Skyscraper 486/25c for video, not disk performance. The Mentor video board, with its Tseng Laboratories chip set and 1MB of video RAM, produced a better-than-average video test score. The Adaptec SCSI controller performs badly on sequential reads, and the 18-ms.-rated Seagate drive may have contributed to the poor disk score. The Skyscraper's narrow, solid tower case and relatively low price make it somewhat appealing, but other systems offer better value.

Accordingly, it has no FCC Class B certification.

ARC says that you can put up to 32MB of RAM on the motherboard (though, with the main exceptions of *NetWare 386* and Unix, most operating environments don't recognize more than 16MB), using up to eight 4MB SIMMs. Having all the RAM right on the motherboard can save an expansion slot and also tends to give you faster throughput, although the ARC Skyscraper yielded only average performance on our benchmark tests. The RAM chips used in the computer are rated at 80 nanoseconds, which may explain why the machine did not achieve faster processor and memory scores. One area in which the ARC Skyscraper performed poorly was on our disk drive tests: It came in last in this review group. Here, the Adaptec SCSI controller may be the culprit: We have seen sluggish results on sequential disk

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—Apple Computer

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But while Apple has taken great strides in making the personal computer more useful, we've gone substantially farther.

Introducing the T2000SX notebook computer.

Quite simply, the T2000 SX is a more useful personal computer because it allows you to work how you want to work. When you want to work. And where you want to work.

Painstakingly engineered with you clearly in mind, the T2000SX will help you work more efficiently than ever before.

Virtually every feature you can find on a desktop computer, you will

Our technologically superior battery can be fully recharged in a mere ninety minutes.

find on the T2000SX: An 80386™SX processor with a math coprocessor socket, VGA compatible display, 1 MB (expandable to 9MB) of 80 nsec RAM, a 40 MB hard disk with 19 msec access time and 1.5 MB/sec data transfer rate.

The T2000SX has a 40MB hard disk with 19 msec access time.

But more important than the specs themselves, is the way the T2000SX lets you use them. Which is more often.

Our fluorescent side-lit screen provides even distribution of light. (Actual size.)

Welcome to the next generation in personal computing.

Because the T2000SX can fit easily into a briefcase (it weighs a scant 6.9 pounds), you can take it anywhere you go and use it in more ways than you can imagine.

Need to make revisions to a

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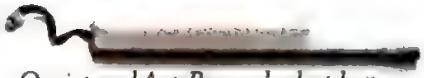

Our internal AutoResume back up battery automatically saves your work if your main battery runs out.

business proposal? The T2000SX gives you the freedom to do it from a train. The client wants an estimate on costs? You can give it to him right then and there—wherever there is.

No more wasting time running back to the office. Because the office is always with you.

But just in case there's something back at the office you still need, you can get back to it with our optional built-in modem. Which supports industry standard error corrections and data compression (CCITT V.42, V.42bis, MNP® 5). It even supports cellular data communications via our optional smart cable adapter.

Our user-installed memory card allows you to add up to 8 MB of memory yourself.

The T2000SX also has a unique feature you won't find on any other computer in the world. It is called AutoResume.

AutoResume: Think of it as a bookmark for your computer.

AutoResume automatically saves whatever you're working on whenever you turn the computer off. And it lets you go directly to the program you were using last when you're ready to start up again. So you don't have to reboot, restart your application and reload your files.

AutoResume also helps save on battery life and it allows you to change batteries without losing an ounce of information.

The T2000SX comes complete with Hypertext on-line documentation.

As for batteries, the T2000SX touts the latest in battery technology —Nickel Hydride. Nickel Hydride delivers 22% more watt-hours per pound than NiCad and it doesn't suffer from memory effect.

In keeping with the Toshiba tradition, the T2000SX also offers superior ergonomics. Like full-size, standard-spaced keys on a keyboard which has a full set of 12 dedicated function and 8 cursor control keys. And a VGA compatible, reversible black on white or white on black high resolution display.

Okay, let's wrap this thing up.

These are just a few of the reasons why we believe the T2000SX is the most useful, and therefore, most powerful computer in the world. And why P.C. Week* Labs said, "*the T2000SX offers performance comparable to the LTE 386s/20, plus many of the design features that have made Toshiba a market leader in portable PCs.*" PC WEEK

We invite you to learn more about the T2000SX and Toshiba's best-selling line of portable computers by calling us at **1-800-457-7777** for a complete information kit.

In closing, we'd like to thank you for reading our ad.

We'd also like to thank our friends at Apple for giving us such a wonderful endorsement.

The T2000SX has an optional modem that allows data communications via a cellular phone.

In Touch with Tomorrow

TOSHIBA

CIRCLE 379 ON READER SERVICE CARD

25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Acer 1170	Acer 1200	ACMA 486/25I Engineering Workstation	ACMA 486/25E Engineering Workstation	Advanced Logic Research BusinessVEISA	AGI 4100A
List price (standard configuration)	$7,564	$10,064	$4,195	$6,595	$9,669	$6,995
Standard hard disk capacity	200MB	200MB	210MB	342MB	330MB	300MB
Distribution channel	Dealers	Dealers	Direct	Direct	Dealers	Dealers
Bus architecture	ISA	EISA	ISA	EISA	EISA	ISA
Case type	Small-footprint	Tower	Desktop	Tower	Small-footprint	Tower
Dimensions (HWD, in inches)	5 x 14 x 16.2	21 x 6 x 17	6.5 x 21 x 16.5	25.5 x 7.5 x 17.5	6 x 15 x 17	26 x 7 x 18.5
Motherboard manufacturer	Acer	Acer	Free Technology	Free Technology	ALR	Everex/Parcorp
80486 chip set manufacturer	Discrete logic	Discrete logic	Intel	Intel	C&T	Discrete logic
System RAM arrangement	Interleaved page	Interleaved page	Interleaved page	Interleaved page	Interleaved page	Page mode
MEMORY AND PROCESSOR RAM CACHE						
Installable RAM	4MB–64MB	4MB–64MB	1MB–16MB	1MB–64MB	1MB–49MB	1MB–16MB
Cache controller	None	Acer	Discrete logic	Discrete logic	Intel	Discrete logic
Installable cache RAM	N/A	128K	64K, 256K	64K, 256K	64K	64K, 256K
BIOS						
BIOS version	Acer 80486 100	Acer EISA 80486 V1.0R1	AMI 1.2F	Award 4.10	Phoenix 1.00.07	AMI (September 1990)
Setup/password in ROM	■/■	■/■	■/❑	■/❑	■/■	■/❑
System shadowing/video shadowing	■/■	■/■	■/■	■/■	■/■	❑/❑
DISK DRIVES						
Drive bays	4 3.5-inch	5 half-height	5 half-height	6 half-height	2 half-height, 2 3.5-inch	2 full-height, 4 half-height
Controller integrated on motherboard	■	❑	❑	❑	❑	❑
Hard disk options	40MB–200MB	40MB–338MB	40MB–210MB	150MB–700MB	40MB–660MB	160MB–677MB
Minimal floppy disk configuration	1.44MB	1.2MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB
EXPANSION BUS						
Expansion slots:						
8-bit	None	None	None	None	1 (open)	1 (open)
16-bit	4 (3 open)	None	8 (5 open)	2 (none open)	2 (2 open)	6 (3 open)
32-bit EISA/MCA	None	8 (5 open)	None	6 (4 open)	3 (2 open)	None
32-bit proprietary	None	None	None	None	3 (1 open)	1 (open)
Ports originate on motherboard	❑	❑	❑	❑	❑	❑
Dedicated mouse port	■	■	❑	❑	■	❑
VIDEO						
Display mode	VGA	VGA	Super VGA	Super VGA	Super VGA	Super VGA
Display circuitry location	Card	Card	Card	Card	Card	Card
Interface	16-bit	16-bit	16-bit	16-bit	32-bit	16-bit
Video adapter manufacturer	ATI	ATI	Orchid	Orchid	ALR	Everex
Chip set manufacturer	ATI	ATI	Tseng	Tseng	Paradise	Tseng
SOFTWARE						
DOS	3.3, 4.01 ($150)	3.3, 4.01 ($150)	4.01	4.01	4.01	4.01 ($110)
Other software	*Windows* 3.0 with mouse	*Windows* 3.0 with mouse	*Windows* 3.0	*Windows* 3.0	ALR utilities, EISA utilities	None
MISCELLANEOUS						
Supports Weitek coprocessor	■	■	■	■	■	■
Keyboard manufacturer	Acer	Acer	Maxi-Switch	Maxi-Switch	NMB	Key Tronic
Power supply (watts)	145	230	200	300	150	250
Number of device connectors	4	5	4	4	4	6
Keyboard/case lock	Side/side	Front/front	Front/front	Front/none	Front/front	None/none
Power-on/reset switch	Front/front	Front/front	Side/front	Front/front	Front/front	Front/front
Warranty	2 years	2 years	1 year parts, 2 years labor	1 year parts, 2 years labor	1 year	1 year
Service	Vendor	Vendor	On-site	On-site	Dealer, vendor	Dealer
FCC Class B identification number	GQ81170	GQ81200-25	None	None	E7Y25486MODDT	E3EEX4100A

★—Editors' Choice ■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.
AIR—Advanced Integration Research Inc., AMI—American Megatrends Inc., ATI—ATI Technologies Inc., C&T—Chips and Technologies Inc., TI—Texas Instruments Inc., TMC—TMC Research Corp., WD—Western Digital Corp.

Amax 486 EISAmax	American Research Corp. Skyscraper 486/25c	Apricot Qi 900	Austin Winstation 486/25e	Blue Star 486/25c	Boss 486 Model 4625	Bus 486-25	C² Microsystems 486-25	Cheetah Gold 425
$6,910	$3,515	$8,895	$6,995	$3,799	$5,895	$3,799	$4,200	$10,489
210MB	183MB	200MB	330MB	211MB	200MB	200MB	200MB	200MB
Dealers	Dealers, direct	Dealers	Direct	Dealers, direct	Dealers	Direct	Dealers, direct	Dealer, direct
EISA	ISA	MCA	EISA	ISA	ISA	ISA	ISA	ISA
Tower	Tower	Small-footprint	Desktop	Tower	Tower	Tower	Desktop	Tower
24.5 x 7.5 x 17	23.8 x 6.5 x 18	5.5 x 15.5 x 16.5	6.5 x 21 x 16.5	23.8 x 6.4 x 19.1	24 x 7.1 x 17.2	24.3 x 8.8 x 20.3	6 x 21 x 16.5	24 x 7.5 x 22.5
Free Technology	Beaver	Apricot	Micronics	AIR	Vantage	Micronics	TMC	Cheetah
Intel	TI	C&T	Discrete logic	C&T	OPTi	TTL	OPTi	Discrete logic
Page mode	Page mode	Interleaved page	Interleaved page	Interleaved page	Page mode	Page mode	Page mode	Interleaved page
1MB–64MB	1MB–16MB	1MB–80MB	4MB–64MB	1MB–16MB	1MB–16MB	1MB–8MB	1MB–32MB	8MB–16MB
Discrete logic	Austek	Intel	Discrete logic	Discrete logic	None	Discrete logic	TMC	None
64K, 256K	64K, 128K	128K	64K, 128K, 256K	128K	N/A	64K, 128K, 256K	128K	N/A
Award BIOS 4.1	Award 3.12	Phoenix 1.02.20	Phoenix EISA 80486 1.00.11	AMI (May 1990)	Award 3.10	Phoenix 0.10F9	Award 3.03SX	Award 3.05KK
■/❑	■/■	❑/■	■/❑	■/❑	❑/❑	❑/❑	■/❑	■/❑
■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■
6 half-height	2 full-height, 2 3.5-inch	2 3.5-inch	5 half-height	4 half-height, 3 3.5-inch	6 half-height, 2 3.5-inch	2 full-height, 5 half-height	1 full-height, 3 half-height	8 half-height
❑	❑	❑	❑	❑	❑	❑	❑	❑
40MB–346MB	89MB–300MB	100MB–320MB	40MB–1.2GB	87MB–1.05GB	80MB–660MB	45MB–760MB	80MB–675MB	40MB–1.2GB
1.2MB or 1.44MB	1.2MB or 1.44MB	1.44MB	1.2MB	1.2MB or 1.44MB	1.2MB, 1.44MB	1.2MB or 1.44MB	1.2MB or 1.44MB	1.2MB
None	2 (2 open)	None	None	None	None	None	1 (none open)	1 (open)
2 (1 open)	6 (3 open)	2 (1 open)	1 (none open)	8 (5 open)	8 (6 open)	8 (5 open)	7 (5 open)	7 (4 open)
6 (1 open)	None	2 (2 open)	7 (5 open)	None	None	None	1 (none open)	None
None	None	None	None	None	None	None	2 (1 open)	1 (none open)
❑	❑	■	❑	❑	❑	❑	❑	❑
❑	❑	■	❑	❑	❑	❑	❑	❑
1,024 by 768	1,024 by 768	1,024 by 768	1,024 by 768	1,024 by 768	Super VGA	Super VGA	1,024 by 768	Super VGA
Card	Card	Motherboard	Card	Card	Card	Card	Card	Card
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Orchid	Mentor	C&T	Tseng	Diamond	Cardinal	Orchid	ATI	Micro Labs
Tseng	Tseng	C&T	Tseng	Tseng	Tseng	Tseng	ATI	Tseng
4.01	4.01	3.3, 4.01	4.01	3.3, 4.01	4.01	4.01	4.01	4.01
Windows 3.0	*Windows* 3.0	OS/2 ($395)	*Windows* 3.0	*PC-Calc, PC-File, PC-Write*	Cardinal SVGA utilities	None	*Windows* 3.0	*Windows* 3.0 with mouse
■	■	❑	■	■	❑	■	❑	❑
Maxi-Switch	Chicony	Apricot	Chicony	NTC	Honeywell	MCK	Focus	Cheetah
250	300	145	220	250	300	250	300	300
4	5	3	4	5	6	4	4	4
Front/none	Front/none	None/back	Front/none	Front/none	Front/none	Front/back	None/none	Front/none
Front/front	Front/front	Side/none	Side/front	Front/front	Front/front	Front/front	Side/front	Front/front
1 year	1 year	1 year	1 year	1 year system, 4 years system parts	2 years	1 year	1 year	1 year
Dealer	Dealer, vendor, on-site	Dealer	On-site	Vendor	On-site	On-site	Dealer, vendor	Phone service
None	None	None	None	None	B pending	None	None	EZL425T

CONTINUES

25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Club 486 Hawk II	Computer Market Place Ultra 486	Copam 486/25 EISA	CSS MaxSys 486 MTE/25	Dataworld Data 486-25	Dell System 425TE
List price (standard configuration)	$3,995	$3,976	$8,779	$10,962	$4,545	$7,818
Standard hard disk capacity	338MB	208MB	200MB	340MB	210MB	190MB
Distribution channel	Dealers, direct	Direct	Dealers	Dealers	Direct	Dealers, direct
Bus architecture	ISA	ISA	EISA	EISA	ISA	EISA
Case type	Tower	Desktop	Tower	Tower	Desktop	Tower
Dimensions (HWD, in inches)	24.5 x 8.5 x 20.5	7.5 x 24.5 x 17.5	27 x 6.5 x 18	25.3 x 7.5 x 15.8	6.5 x 21 x 16.5	24 x 7.6 x 22.3
Motherboard manufacturer	Club AT	Cache	Copam	CSS	Dataworld	Dell
80486 chip set manufacturer	VLSI Tech	OPTi	Intel	Intel, discrete logic	Intel	Intel
System RAM arrangement	Interleaved page	Page mode	Page mode	Page mode	Page mode	Interleaved page
MEMORY AND PROCESSOR RAM CACHE						
Installable RAM	1MB–16MB	1MB–16MB	2MB–32MB	1MB–64MB	1MB–16MB	4MB–64MB
Cache controller	Club	OPTi	Intel	None	OPTi	None
Installable cache RAM	64K, 256K	128K	128K, 256K	64K, 128K	128K	N/A
BIOS						
BIOS version	AMI 6132	Cache BAT486 1.07	Phoenix 1.005E	Award BIOS 4.0	AMI EPOB-1131-040990-K8	Phoenix 1.00 A02
Setup/password in ROM	■/❑	■/❑	■/❑	■/❑	■/❑	■/■
System shadowing/video shadowing	■/■	■/■	■/■	■/■	■/■	■/■
DISK DRIVES						
Drive bays	5 half-height, 2 full-height	1 full-height, 4 half-height	7 half-height	5 half-height	5 half-height	11 half-height
Controller integrated on motherboard	❑	❑	❑	❑	❑	❑
Hard disk options	40MB–651MB	41MB–676MB	44MB–6GB	20MB–1.2GB	40MB–676MB	80MB–650MB
Minimal floppy disk configuration	1.2MB	1.2MB	1.2MB or 1.44MB	1.2MB	1.2MB	1.2MB or 1.44MB
EXPANSION BUS						
Expansion slots:						
8-bit	None	None	None	None	None	None
16-bit	7 (5 open)	8 (5 open)	2 (1 open)	5 (2 open)	6 (4 open)	None
32-bit EISA/MCA	None	None	6 (4 open)	6 (5 open)	None	8 (7 open)
32-bit proprietary	1 (open)	None	None	1 (none open)	2 (2 open)	None
Ports originate on motherboard	■	❑	❑	❑	❑	■
Dedicated mouse port	❑	❑	❑	❑	❑	■
VIDEO						
Display mode	Super VGA	1,024 by 768	Super VGA	1,024 by 768	1,024 by 768	VGA
Display circuitry location	Card	Card	Card	Card	Card	Motherboard
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Video adapter manufacturer	Genesis	Orchid	Headland	Paradise	Orchid	Dell
Chip set manufacturer	Tseng	Tseng	G2	Paradise	Tseng	WD
SOFTWARE						
DOS	4.01	4.01	4.01	4.01	4.01 ($85)	3.3 ($100), 4.01 ($119)
Other software	*Windows* 3.0	None	None	None	None	Diagnostics, EISA configuration utility, tutorial
MISCELLANEOUS						
Supports Weitek coprocessor	■	❑	❑	■	■	■
Keyboard manufacturer	NMB	Focus	Copam	Se Jin	Focus	Alps
Power supply (watts)	250	220	220	300	200	300
Number of device connectors	6	4	4	3	4	6
Keyboard/case lock	Front/back	Front/none	Front/none	Front/none	Front/none	Side/none
Power-on/reset switch	Front/front	Front/front	Front/front	Front/front	Side/front	Front/front
Warranty	1 year	1 year system, 2 years mother-board and RAM	1 year	18 months	1 year	1 year
Service	On-site	Vendor	On-site	On-site	On-site	On-site
FCC Class B identification number	IP5-TX-425T	None	DXO 486 V25	None	GS8TDATA-EC45	E2K425TE

PC—Editors' Choice ■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.
AIR—Advanced Integration Research Inc., AMI—American Megatrends Inc., ATI—ATI Technologies Inc., C&T—Chips and Technologies Inc., TI—Texas Instruments Inc., TMC—TMC Research Corp., WD—Western Digital Corp.

DTK FEAT-2502	Dynamic Decisions Dynex 486 ISA	Dynamic Decisions Dynex 486E	Dyna Work Master 486 25 Cache	Dyna Work Master 486 25 Cache EISA	EPS 486/25 Tower	HP Vectra 486	HIQ 425I
$5,514	$4,730	$5,950	$4,639	$6,689	$4,195	$13,395	$3,699
200MB	200MB	340MB	337MB	337MB	200MB	330MB	200MB
Dealers	Dealers, direct	Dealers, direct	Dealers, direct	Dealers, direct	Direct	Dealers, direct	Direct
ISA	ISA	EISA	ISA	EISA	ISA	EISA	ISA
Tower	Desktop	Desktop	Mini-tower	Mini-tower	Tower	Tower	Tower
21 x 7 x 20	6.3 x 21 x 16.5	6.3 x 21 x 16.5	16 x 7.8 x 16	16 x 7.8 x 16	26 x 7.5 x 18	24 x 8.5 x 14	25.5 x 7.5 x 17.5
DTK	AMI	AMI	AIR	AIR	EPS	HP	Free Technology
VLSI Tech, discrete logic	C&T	Intel	C&T, discrete logic	C&T, discrete logic	OPTi	Intel	Intel
Interleaved page	Page mode	Page mode	Row/column	Page mode	Interleaved page	Interleaved page	Page mode
1MB–16MB	1MB–48MB	1MB–96MB	1MB–16MB	1MB–64MB	1MB–16MB	2MB–64MB	1MB–16MB
DTK	AMI	DPT	Discrete logic	Discrete logic	OPTi	None	Discrete logic
64K, 256K	128K	64K, 256K	128K, 256K	64K, 256K	128K	N/A	64K, 256K
DTK 4.26	AMI (April 1990)	AMI V60-1.03	AMI (May 1990)	Phoenix (May 1990)	AMI 4.0	HP G.03.01	AMI (April 1990)
■/■	■/❑	■/❑	■/❑	■/❑	■/■	■/■	■/❑
❑/❑	■/■	■/■	■/■	■/■	■/■	■/■	■/■
1 full-height, 5 half-height	5 half-height	5 half-height	3 half-height, 2 3.5-inch	3 half-height, 2 3.5-inch	6 half-height, 2 3.5-inch	6 half-height	6 half-height
❑	❑	❑	❑	❑	❑	❑	❑
80MB–201MB	40MB–1.3GB	140MB–1.3GB	42MB–676MB	91MB–676MB	40MB–676MB	84MB–1000MB	100MB–350MB
1.2MB	1.2MB or 1.44MB	1.2MB or 1.44MB	1.2MB	1.2MB	1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB
1 (open)	1 (none open)	None	None	None	2 (1 open)	None	None
6 (4 open)	6 (4 open)	None	8 (5 open)	None	6 (4 open)	None	8 (5 open)
None	None	7 (3 open)	None	8 (5 open)	None	8 (6 open)	None
1 (open)	1 (none open)	1 (open)	None	None	None	None	None
❑	❑	❑	❑	■	❑	❑	❑
❑	❑	❑	❑	❑	❑	■	❑
1,024 by 768	Super VGA	Super VGA	Super VGA	Super VGA	1,024 by 768	Super VGA	Super VGA
Card	Card	Card	Card	Card	Card	Card	Card
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
DTK	ATI	ATI	Orchid	Orchid	Orchid	HP	Orchid
Trident	ATI	ATI	Tseng	Tseng	Tseng	HP	Tseng
4.01	4.01	4.01	4.01	4.01	4.01	4.01 ($150)	3.3, 4.01 ($60)
None	*Windows* 3.0 ($95)	*Windows* 3.0 ($95)	None	None	*Windows* 3.0	EMM, OS/2 ($369), setup configuration utility	None
■	■	■	■	■	■	❑	■
Focus	Chicony	Chicony	Maxi-Switch	Maxi-Switch	Fujitsu	HP	BTC
200	230	230	230	230	220	264	230
5	6	6	6	6	5	6	4
Front/none	Back/none	Back/none	None/none	None/none	Front/none	Front/back	Front/none
Front/front	Side/front	Side/front	Front/front	Front/front	Front/front	Front/none	Front/front
1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year parts, 2 years labor
Dealer	On-site	On-site	On-site	On-site	On-site	Vendor	Vendor
F825K4FEAT2502	None	None	None	None	None	None	None

ENDS

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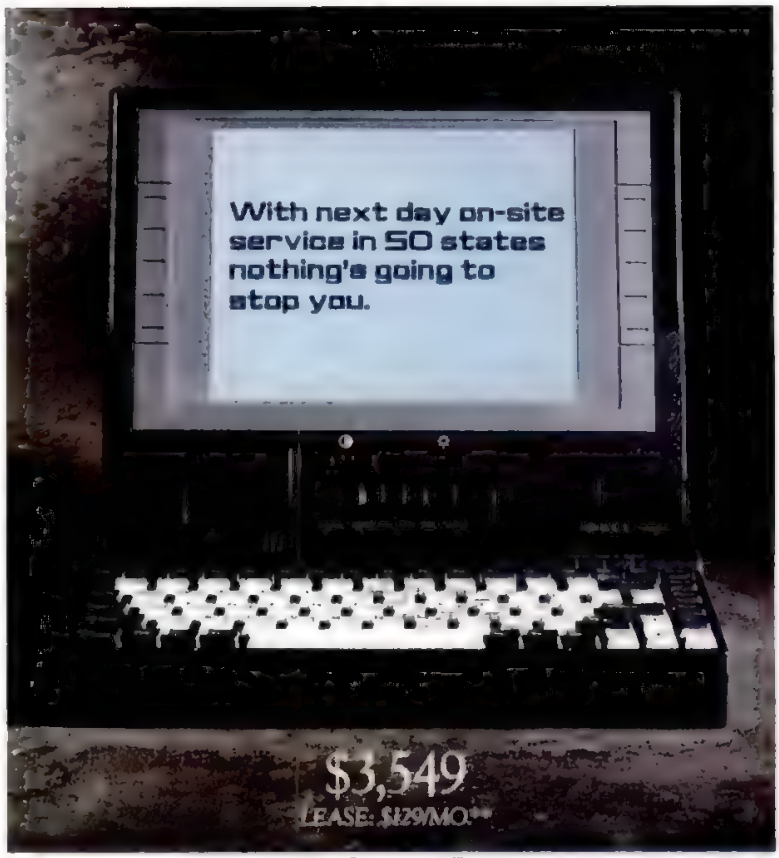

DELL SYSTEM® 320N 386™SX 20 MHz
SYSTEM INCLUDES VGA LCD, 30 MB HARD DRIVE, 2 MB RAM.

THE NEW DELL SYSTEM 320N 20 MHz 386SX AND THE NEW DELL SYSTEM 212N 12 MHz 286.

- Intel® 80386SX microprocessor running at 20 MHz (320N) and the Intel 80C286 microprocessor running at 12 MHz (212N).
- Standard 1 MB of RAM,* expandable to 5 MB (on the system board using 1 MB or 2 MB memory modules).
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- 1 serial port and external VGA monitor port.
- Selectable parallel printer or external 5.25" disk drive/tape back-up port.
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- Mouse port.
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212N: 20 MB, 1 MB RAM* $2,399
320N: 30 MB, 1 MB RAM* $3,399

40 MB hard drive configuration also available for the 212N.
40 MB and 60 MB hard drive configurations also available for the 320N.

*Performance Enhancements. Within the first megabyte of memory 96 KB of memory is reserved by the system to enhance performance. Can be optionally disabled. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. **Payment based on 36-month, open-end lease. ◊ Leasing arranged by Leasing Group, Inc. In Canada and Mexico, configurations and prices may vary. Dell and Dell System are registered trademarks of Dell Computer Corporation. Intel is a registered trademark and 386 is a trademark of Intel Corporation. Other trademarks and trade names are used to identify entities claiming the

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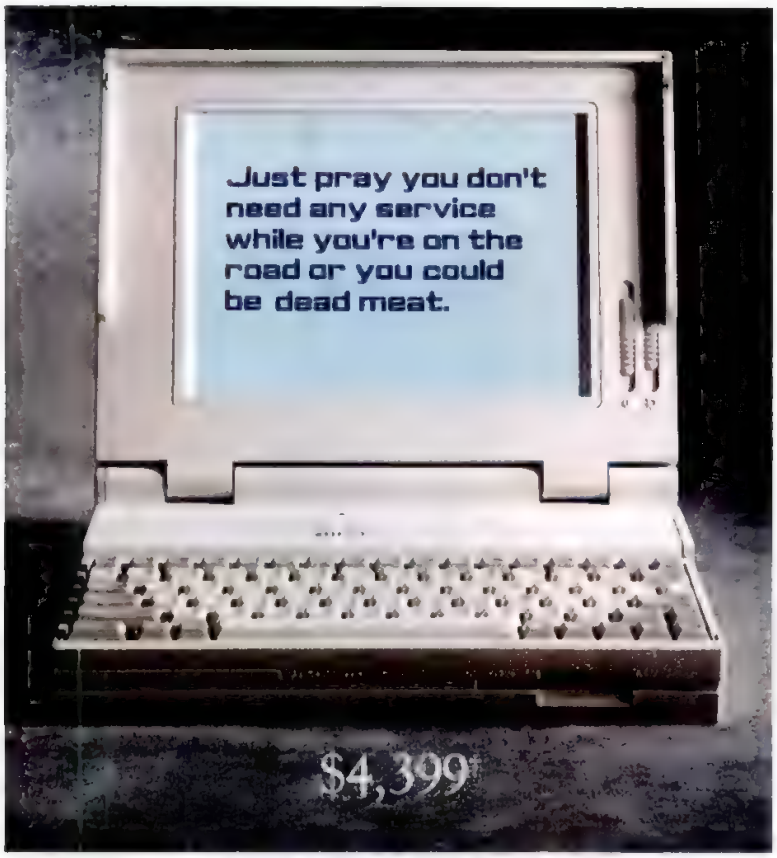

COMPAQ LTE 386s/20 386SX 20 MHz
SYSTEM INCLUDES VGA LCD, 30 MB HARD DRIVE, 2 MB RAM.
ACTUAL DEALER PRICES MAY VARY.

technician will come to your hotel room, or office,△ the next business day with a replacement system if necessary. And if possible, your hard drive contents will be transferred on the spot. All at no additional cost for the first year you own your computer.

It's light weight. But it's no lightweight.

Dell's notebook weighs just 6.4 pounds. (1.1 pounds lighter than the Compaq LTE 386s/20). It measures a trim 8½" x 11" x 2". But technically, this is heavy artillery.

The Dell 320N features a built-in 3.5" diskette drive with your choice of high-speed 30, 40 or 60 MB hard drives.

The display is a high quality VGA LCD. There's an optional, built-in Data/FAX modem. And a sliding door that lets you easily insert a math coprocessor, RAM modules or the modem without major surgery. (Dell also has the 212N, a 12 MHz 286 with a 20 or 40 MB hard drive.)

Even the keyboard shows touches of brilliance. It's a complete 85-key layout. Including the special screen navigation keys (Home, End, Page Up, Page Down and separate Cursor keys in the familiar inverted "T" layout) that let you easily navigate even the most spread-out spreadsheet. And every key is engineered for extended travel, to provide the familiar touch of a top-of-the-line desktop system.

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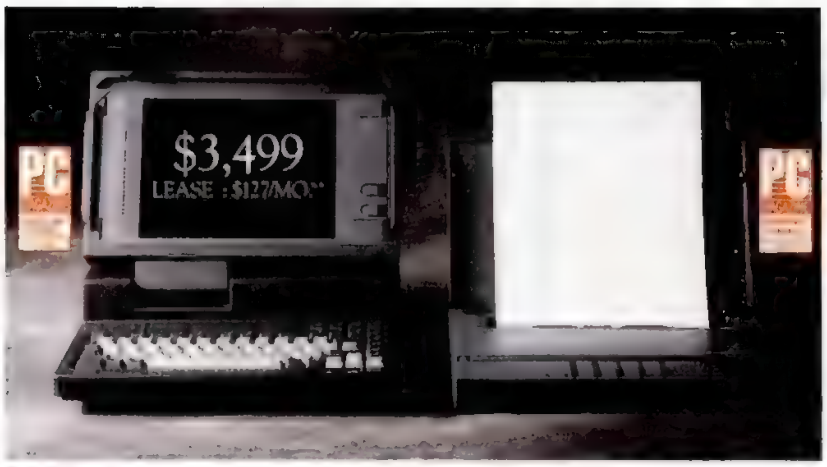
CIRCLE 474 ON READER SERVICE CARD

WE'VE GOT ONE FOR PEOPLE WHO SOMETHING EX THROWN IN FOR

OKAY.



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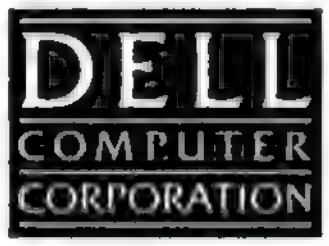

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CIRCLE 532 ON READER SERVICE CARD

BENCHMARK TESTS: 25-MHz 486-BASED PCs

PC LABS

Caching disk controllers accounted for a 10-second gap in disk test scores. Except for the IBM PS/2 Model 90, systems without a disk cache took 49 seconds or more to run through our tests. Those with a cache produced scores of 39 seconds or less.

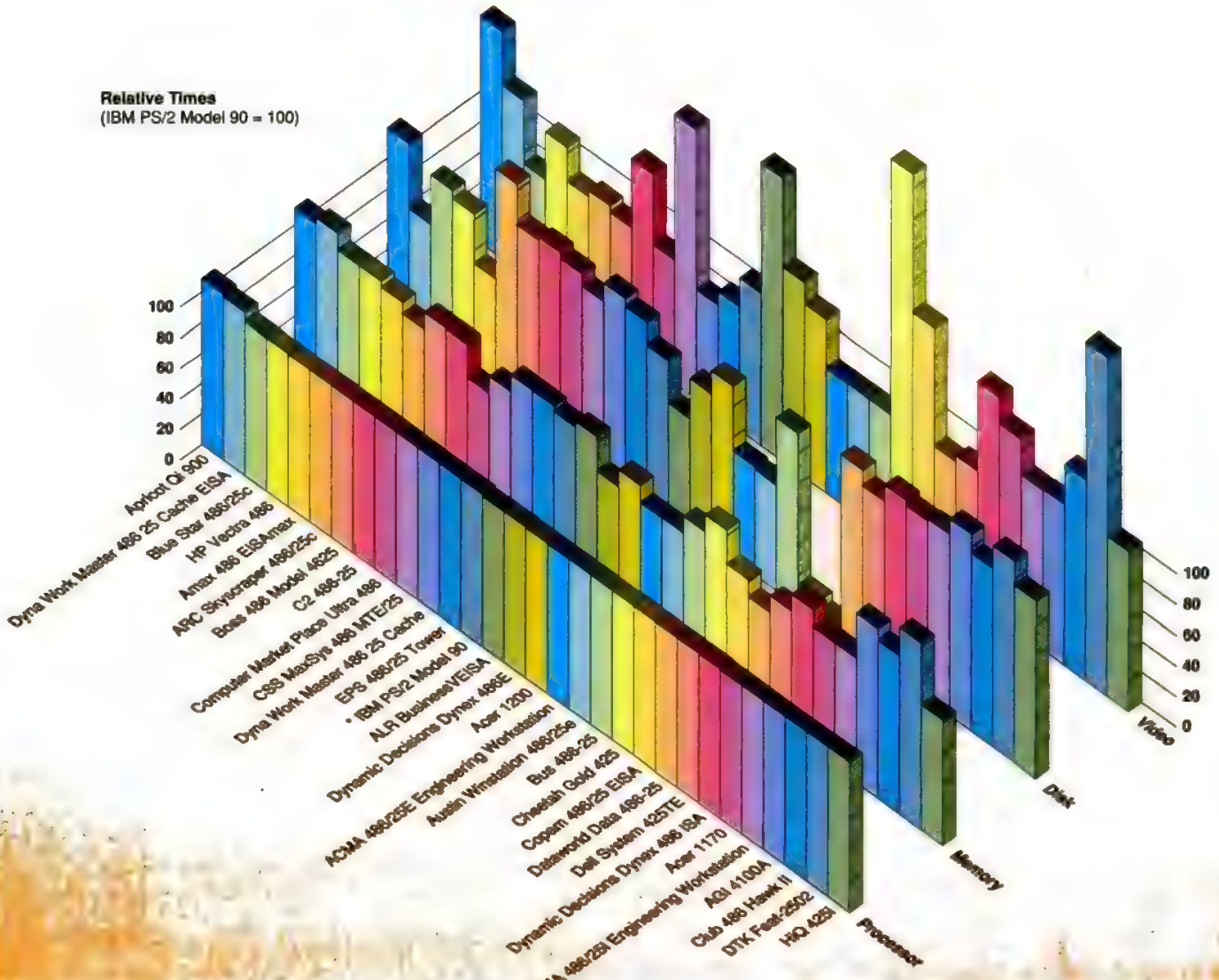
TESTING ANALYSIS

External processor RAM cache had little effect on processor performance, if any. In many cases, systems with a small cache (or none at all) outperformed more-heavily cached systems. Both processor and memory times are tightly clustered, regardless of bus architecture; only a few scores stand out, marginally, one way or the other.

This clustering changes when we look at disk performance. Three groups of scores emerged when we tested hard disks and their controllers—groups predominantly based on cache. The slowest systems had uncached controllers, and their scores ranged from 49.25 to 72.20 seconds. A second group, with scores from 34.89 to 38.58 seconds, had controllers with up to 1MB of cache on-board. Finally, two systems whose controllers had both cache and microprocessors on-board produced scores of less than 7 seconds.

Bus architecture affected disk scores as well. The five noncached EISA systems garnered five of the top seven scores—including the top three (Dynamic Decisions, HP, and CSS)—among noncached systems tested here.

As for video, Orchid's ProDesigner II card and the Diamond SpeedStar VGA cards, with their Tseng Laboratories chip sets, came in the systems with the fastest video scores.



(Shorter bars represent better performance.)
* IBM PS/2 Model 90 reported for comparison.

HIGHLIGHTS

❶ Apricot Processor
The Apricot Qi 900 not only had the worst processor time but performed poorly across all of our tests. This system was the only MCA machine reviewed in this issue.

❷ DTK Processor
While the DTK Feat-2502's processor score tied for first place, its memory, disk, and video times were poor. Part of this can be traced to the DTK motherboard and Trident video card.

❸ ARC Disk
The ARC Skyscraper 486/25c's Adaptec SCSI controller performed poorly on sequential reads. As a result, the system's Seagate hard disk turned in a poor score.

❹ Cheetah Disk
A microprocessor on the Cheetah Gold 425's Hyperstor controller (with 512K cache) helped produce sub-7-second disk test performance.

❺ Copam Disk
The Copam 486/25 EISA has a microprocessor on its caching Mylex controller. The EISA bus and 1MB cache helped this system outperform even the lightning-fast Cheetah Gold 425.

❻ Cheetah Video
The Cheetah Gold 425's excellent disk performance did not carry over into the video test. Its Micro-Labs card probably suffered from the system's 6-MHz I/O speed.

	Processor (seconds)	Memory (seconds)	Disk (seconds)	Video (seconds)
Apricot Qi 900	1.61 ❶	0.30	60.25	1.81
Dyna Work Master 486 25 Cache EISA	1.58	0.31	38.58	1.38
Blue Star 486/25c	1.49	0.28	54.90	0.88
HP Vectra 486	1.49	0.28	52.16	1.26
Amax 486 EISAmax	1.48	0.27	35.92	0.99
ARC Skyscraper 486/25c	1.48	0.25	72.20 ❸	1.04
Boss 486 Model 4625	1.48	0.28	58.86	0.99
C² 486-25	1.48	0.28	60.05	1.54
Computer Market Place Ultra 486	1.48	0.22	58.03	0.98
CSS MaxSys 486 MTE/25	1.48	0.25	54.08	2.14
Dyna Work Master 486 25 Cache	1.48	0.28	60.24	0.87
EPS 486/25 Tower	1.48	0.28	57.53	0.98
* IBM PS/2 Model 90	1.48	0.27	50.18	1.21
ALR BusinessVEISA	1.46	0.28	36.06	2.25
Dynamic Decisions Dynex 486E	1.46	0.22	49.25	1.54
Acer 1200	1.45	0.25	56.86	1.37
ACMA 486/25E Engineering Workstation	1.45	0.22	35.84	0.99
Austin Winstation 486/25e	1.45	0.22	34.89	0.99
Bus 486-25	1.45	0.25	56.83	0.99
Cheetah Gold 425	1.45	0.28	6.94 ❹	3.02 ❻
Copam 486/25 EISA	1.45	0.22	3.85 ❺	1.92
Dataworld Data 486-25	1.45	0.19	60.18	0.99
Dell System 425TE	1.45	0.22	55.19	1.04
Dynamic Decisions Dynex 486 ISA	1.45	0.25	60.67	1.75
Acer 1170	1.44	0.22	58.88	1.54
ACMA 486/25I Engineering Workstation	1.44	0.22	59.53	1.26
AGI 4100A	1.44	0.30	64.75	1.27
Club 486 Hawk II	1.44	0.28	58.48	1.59
DTK Feat-2502	1.44 ❷	0.33	65.99	2.69
HiQ 425i	1.44	0.22	58.22	1.26

■ The **Instruction Mix** benchmark test times a series of tasks specific to the processor. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

■ The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at relatively slow access speeds.

■ This score is the sum of the small-record and large-record **DOS File Access** benchmark test times. Each test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. No software cache is employed.

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. A good score indicates that information can get to the screen quickly, particularly when programs bypass the computer's video BIOS.

HOW WE TESTED

In testing these 29 486 25-MHz ISA, MCA, and EISA systems, we used PC Magazine Labs' Hardware Performance Tests, Release 5.6, with video and system shadowing enabled wherever possible, and we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests.

We accepted up to 1MB of cache on EISA and MCA hard disk controllers, though we allowed only one caching ISA controller: The Cheetah Gold 425 comes exclusively with the controller we reviewed. You'll get significantly better performance by adding a software disk cache.

The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds, so take this into account when making purchasing decisions based primarily on speed.

read tests of magneto-optical drives using this controller, as well.

ARC offers free on-site service during its one-year warranty on parts and labor. The company that services the on-site contracts for ARC is Video Aid Corp. Its toll-free technical support line is open from 9:00 A.M. to 12:00 midnight EST Monday through Friday and 9:00 A.M. to 6:00 P.M. on Saturday. If a problem can't be cleared up on the phone, a technician is sent out within 48 hours.

The Skyscraper 486/25 is a fairly standard PC. It has a solid, well-designed case and a motherboard that accommodates 32MB of RAM. The machine's appeal rests mostly in its price, which is low enough to make the computer worth a hard second look. This is also quite true of other models that ARC currently sells. In fact, in our standard configuration, the 33-MHz 486 machine costs $3,995—only $400 more than the 25-MHz model—which makes it an even better buy for the money.

APRICOT IN CANADA

Apricot Qi 900

by Steven L. Bender

Ordinarily, when *PC Magazine* reviews a computer, factors such as processor, drive, and video speeds and considerations such as expandability, compatibility, and engineering enter into the evaluation. The Apricot Qi 900, billed as "the ultimate personal workstation," requires us to assess another property: data security.

WIRELESS ENTRY

At $8,895, this MCA-bus, 80486-based member of our review group provides the ultimate in workstation data protection. The key to this is an optional infrared (IR) transmitter/security key coupled with a uniquely keyed case lock. The infrared security system uses a credit-card-sized IR transmitter key. The IR receiver circuitry and the security processor chip are located on the motherboard. This feature requires an optional Apricot Security Environment Software package ($100, including one IR key). Additional, digitally unique IR keys cost $40 each. This sophisticated form of user-access control was originally developed for the United Kingdom Department of Defense. When the security environment is active, no snooper can boot the unit without the proper security key or change the access levels for persons having lower-level keys. But don't lose *your* key. If you do, not even Apricot's own technicians can access the computer. You'll be hard pressed to find a more secure setup.

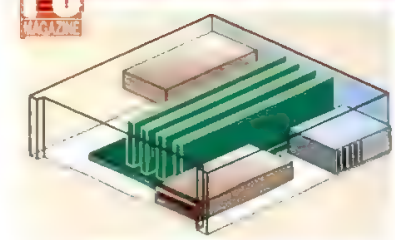
What, besides a svelte, 5.5- by 15.5- by 16.5-inch (HWD) case and a hard-to-foil security system does your $8,900 buy? A Micro Channel version of *PC Magazine*'s standard configuration: 8MB of RAM, 128K processor cache, a 200MB hard disk, 1.44MB floppy disk drive, a Super VGA display, four MCA slots, a fifth slot containing a horizontally mounted proprietary SCSI hard drive controller, DOS 4.01 and 3.3—and precious little else.

POOR PERFORMANCE

The Qi 900 has no disk drive bays other than the ones occupied in our test unit by the 200MB Maxtor LXT-213SY hard disk and 1.44MB floppy. The Maxtor is rated at 17 milliseconds and has a built-in 64K cache buffer. The proprietary Apricot SCSI controller card wasn't available at review time, so the hard disk was paired with the Adaptec SCSI controller. This combination performed poorly on the PC Magazine Labs benchmark tests. If 200MB is too little or too much storage, you can order the system with a 100MB or 320MB hard disk from Apricot at $7,995 or $9,495, respectively. Although there is no room for a second, internal floppy disk drive, you can add an internal tape drive (here, an Irwin 2080 80MB IBM PS-2 Tape/Format Compatible) for $600. As many as six external SCSI hard disks can be added as well.

Even though the Chips and Technologies-based SVGA circuitry, floppy disk controller, and serial, parallel, and mouse ports are on the motherboard, the Qi 900 has only four MCA expansion slots: two 16-bit and two 32-bit. One expansion slot is occupied by the second, optional $150 serial port card required by our standard configuration. Another slot was taken up by the Adaptec controller, leaving our Qi 900 with two free MCA slots. One slot,

FACT FILE



Apricot Qi 900
Apricot In Canada, 111 Granton Dr. #401, Richmond Hill, Ontario L4B1L5 Canada; 416-492-2777.
List price (tested configuration): $8,895.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 17-ms. 200MB SCSI, Adaptec controller, 1.44MB floppy disk drive.
Display: Apricot 512K Super VGA adapter, Apricot 14-inch monitor.
Software: DOS 4.01.

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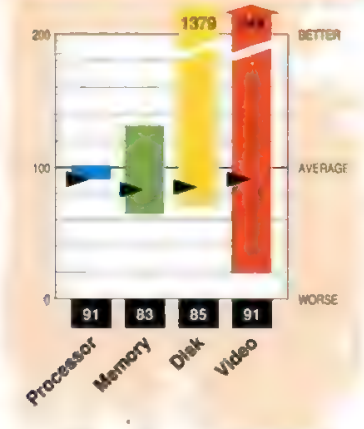
APRICOT QI 900

TEST RESULTS



In Short: If you deal with ultrasensitive data, the Apricot Qi 900, with its wireless infrared transmitter/security key, is the best choice. But don't expect blazing speed. The MCA-bus Apricot performed poorly on all of our benchmark tests. The processor score fell well outside the norm, and the video was far slower than many other systems. Moreover, disk access was slower than many ISA machines. The Apricot is small; it lacks bays and expandability, and service and support require a toll call to Canada.

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(Quarterdeck Office Systems) Say goodbye to memory expansion problems when you install Quarterdeck Expanded Memory Manager 386 (QEMM 386). This award winning utility cleverly manages both extended and expanded memory in 80386, 80386SX and i486 computers, freeing up to an additional 226K for your programs to run in. QEMM 5.1 now supports Microsoft Windows 3.0! **EX1103/5 $61.**

★ M.Y.O.B

(TeleWare) Let M.Y.O.B run your business more efficiently. This integrated accounting program manages your general ledger, checkbook and card file; accounts for your sales and receivables, tracks purchases and payables and monitors your inventory. It even helps you organize your time using its business calendar and to do list. **FN0414 $149.**

★ Crosstalk for Windows

(DCA/Crosstalk Communications) This full powered communications program designed specifically for Windows has all the features you need: full-featured file transfer support, direct interaction with other Windows applications such as Excel, full support for direct host connections and all popular moderns. Cut and paste between Crosstalk and other windows programs and much more. **CM0193/5 $129.**

★ SitBack for Windows

(Sitback Technologies, Inc.) Don't risk losing important data. Let SitBack back up your newly created or modified files automatically. After loading it into memory, SitBack works in the background during idle computer time or at pre-set times without interrupting your work. Issues audio alert if error occurs. Works with Windows, DOS and on networks. **BS3553/5 $85.**

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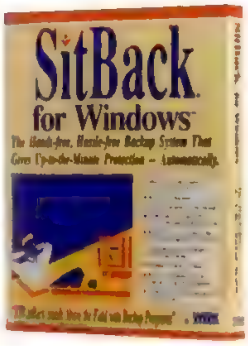

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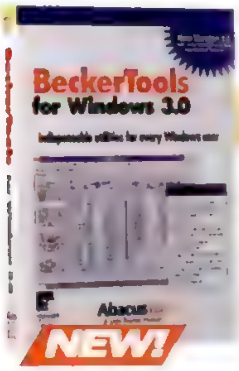
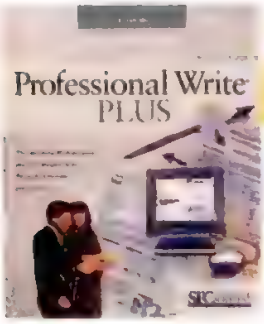


★ BeckerTools 2.0 for Windows

(Abacus) BeckerTools is a high performance file and data management utility replacement for the Windows File Manager. Adds more than 200 functions for daily data, file and directory "housekeeping" - file launching, copying, moving, deleting, searching and formatting- using Windows' point-and-click. Features Undelete, file editing, disk verifying, file archiving and a screen dimmer to protect your monitor. **UT1684 $79**

★ CorelDRAW! 2.0

(Corel Systems) CorelDRAW! is the award winning PC graphics software that gives you incredible type control and superb drawing power in a value-packed program. Now, CorelDRAW! 2.0 comes with more drawing power and over 150 fonts; over 3500 clipart images and symbols; 31 import/export filters; an autotrace utility, a font conversion program and Mosaic, a visual file manager. **GR0543/5 $369.**



★ Professional Write Plus

(Software Publishing) Professional Write PLUS is a Windows word processor designed to improve the productivity of business professionals and the power of their documents. Its unique icon commands cut through complicated menus. Takes full advantage of Windows with WYSIWYG graphics and hot-links and includes a built-in grammar checker and MHS e-mail front end. **WP1523/5 $169.**

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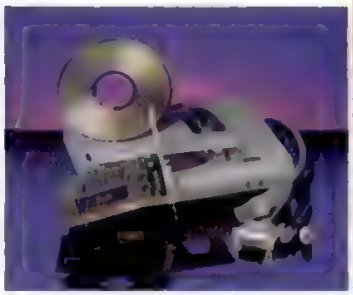

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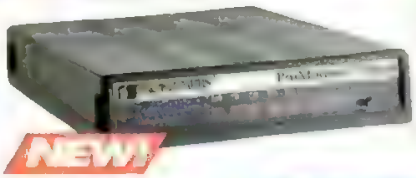

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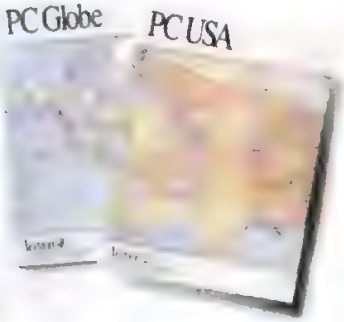

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designated the "V" slot, has pin connectors that can access the on-board VGA chips. If you're using a high-resolution video card to drive a second monitor, this slot enables the Qi 900 to share the video information. A Micro Channel Ethernet card can occupy any of the free slots.

If you're looking for real expansion capabilities, Apricot does offer the Apricot FT Server 486-25, with seven internal drive bays and a built-in 465-watt UPS. But you'll pay nearly twice the price of the Qi 900.

A NONPERFORMER

The Qi 900's scores on the PC Labs benchmark tests were all below average, even though the motherboard comes configured with 128K of 25-nanosecond processor RAM cache. The Qi 900's Instruction Mix test score of 1.61 seconds was the slowest of all machines tested. And the PC's video speed was only half as fast as that of some of the ISA units.

The Apricot Qi 900 allows up to 16MB of RAM on the motherboard in the form of eight 2MB SIMMs; the unit we tested came with eight 1MB SIMMs. System RAM can be expanded to a maximum of 80MB by using two MCA 32MB memory cards.

The motherboard-based VGA adapter uses the Chips and Technologies chip set and 512K of video RAM. It is capable of noninterlaced 1,024- by 768-pixel resolution, but only 16 colors. Three video drivers—those for *Microsoft Windows* 3.0, *AutoCAD* 10, and *WordPerfect* 5.0—are supplied with the Qi 900 for higher-resolution modes.

When the security system is active, no snooper can boot the Apricot without the proper security key. But if you lose your key, you're stuck.

The Apricot 14-inch monitor we tested has dual-mode VGA/Super VGA circuitry based on the Sony Trinitron CRT tube. This is the only monitor bearing the Apricot name, but since Apricot is now a subsidiary of Mitsubishi, the entire line of Mitsubishi monitors is available, too.

Apricot offers a one-year parts-and-labor warranty; at additional cost, on-site service is available, but only in Canada. If you need service, Apricot claims that a technician will be on-site within 4 hours to service a Qi 900 that is within 62 miles of a service center, from 9 A.M. to 5 P.M., 7 days a week. U.S.-based customers will have to pay for a toll call to Canada if they need technical support. Additional U.S. service and support awaits increased U.S. distribution. Presently, only ten VARs handle Apricot computers in the Northeastern U.S.A.

The Qi 900 computer costs about $2,000 more than an equally equipped 80386-based Apricot Qi 600. But despite that extra two grand, the 80486-based Qi 900 lacks the kind of expandability that

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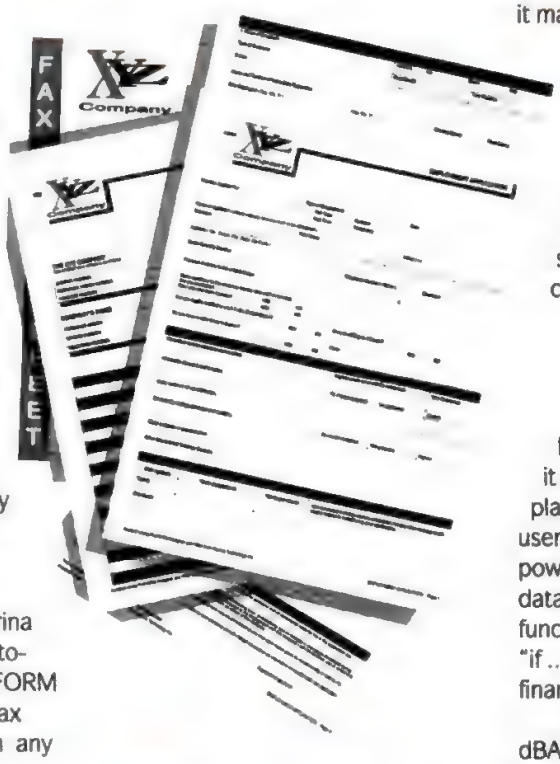

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AUSTIN COMPUTER SYSTEMS

Austin Winstation 486/25e

by Bruce Brown

Austin's reasonably priced 25-MHz 486 EISA offering—the Winstation 486/25e—turns in a good performance and is backed by solid service and support policies. Indeed, its only drawback is that Austin's new 33-MHz 486 EISA is an even better deal!

In the standard configuration, the Austin Winstation 486/25e costs $6,495. It comes with 8MB RAM, 64K RAM cache, 200MB hard disk, a 1,024- by 768-pixel video board with a Super VGA color monitor, and a desktop case. The price also includes *Windows* 3.0 and a Microsoft serial mouse (which Austin bundles with every system). We tested a $6,995 system with a 330MB hard disk and caching disk controller. In either configuration, you're getting a good price for an EISA machine loaded with high-quality components.

Austin uses a Micronics motherboard with an Intel chip set and Phoenix ROM BIOS. All memory fits directly on the motherboard, which handles a healthy maximum of 64MB in its eight SIMM slots. Our test machine used 70-nanosecond 1MB SIMMs. The Micronics board also has an external direct-mapped RAM cache that can hold up to 256K. But unless you have a unique application, the 64K worth of cache supplied in our evaluation unit is ample.

The motherboard also has one 16-bit ISA slot and seven 32-bit EISA expansion slots. All the slots can hold full-length cards. In the standard configuration there are five slots free, with I/O, video, and disk cards each occupying a separate slot. The standard-size desktop case can hold five half-height storage devices, three of which can use removable media. Overall system expansion room is about average for desktop computers, with two half-height bays left free for additional hard disk drives or tape backups.

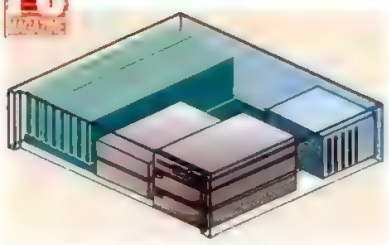
The Austin Winstation 486/25e did especially well on the DOS File Access benchmark test due to its hard disk controller with 1MB cache. It was the only system to include an UltraStor Ultra-22C ESDI caching controller with this amount of cache: UltraStor normally sells 512K and 4MB caching controllers, though Austin says it will sell the 1MB version upon request. This special controller—combined with a 16-millisecond Seagate ESDI hard disk—yielded one of the fastest DOS File Access test scores in this group.

The Austin EISA system fared well enough on the other PC Magazine Labs benchmark tests, yielding average scores on the 80486 Instruction Mix and Conventional Memory tests. The video test time is well above average, thanks to the 1MB RAM Tseng video card that uses Tseng's own top-performing video BIOS chip.

Austin offers a full line of 386 and 486 EISA and ISA machines. A look at the company's pricing levels quickly shows how much less ISA-based machines cost. If you compare the 486/25e to Austin's ISA machines, you'll find that you can buy a similarly configured 486/25 ISA unit for $5,495, a savings of $1,500. Dropping down to an ISA 33-MHz 386 machine with the same memory, drives, and video will save you more than $2,200. So if you don't need or don't want the advantages of the EISA bus (such as the wider bus bandwidth and full 32-bit addressing), you can save lots of money with Austin's ISA machines.

On the other hand, if you have your heart set on an EISA machine, the Austin Winstation version comes in at well below the average price of EISA systems in this roundup. You might even consider Austin's 33-MHz 486 EISA system, which comes in a tower case and, at $7,495, costs just $500 more than our test system—still

FACT FILE

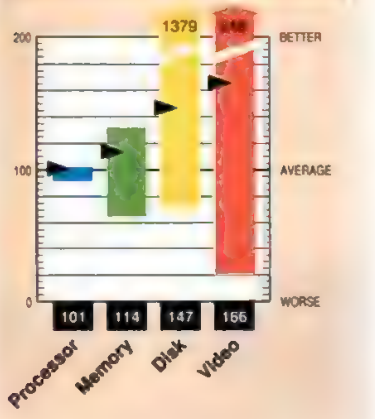


Austin Winstation 486/25e
Austin Computer Systems, 10300 Metric Blvd., Austin, TX 78758; 800-752-1577, 512-339-7932.
List price (tested configuration): $6,995.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 64K cache.
Disk drives and controller: Seagate 16-ms. 330MB ESDI; UltraStor controller, 1MB cache; 1.2MB floppy disk drive.
Display: Tseng Super VGA adapter with 1MB RAM, Mitsubishi 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

CIRCLE 406 ON READER SERVICE CARD

AUSTIN 486/25E

TEST RESULTS



In Short: The Austin Winstation 486/25e's expansion possibilities are mixed, with five free slots but only five half-height drive bays. The Winstation had better-than-average video performance, thanks to the Tseng Laboratories video card, and a top disk score (surpassed only by the two controllers with microprocessors), due to the controller's 1MB disk cache. All looks good here, but the tempting deal on Austin's 33-MHz 486 EISA machine looks even better.

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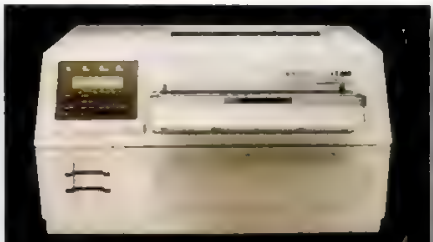
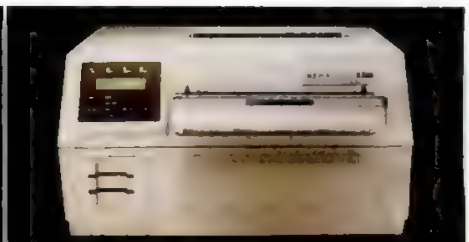


The OL800: 8ppm page printer $1499

The OL820: W/built-in font scaling $1999

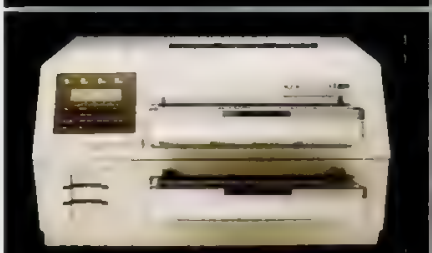


The OL840: W/PostScript $2999

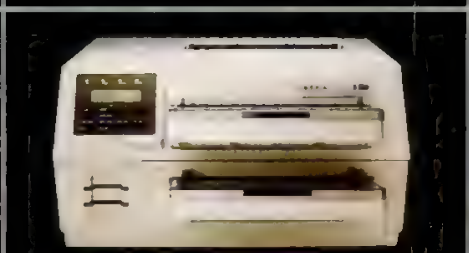
The OL800: W/200 sheet 2nd paper tray

The OL820: W/200 sheet 2nd paper tray

The OL840: W/200 sheet 2nd paper tray



The OL800: W/multi-user port (3 add'l users)*



The OL820: W/multi-user port (3 add'l users)*

The OL840: AppleTalk Network Ready

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The OL820: Faster Than A LaserJet III.

Besides having more resident scalable fonts than the LaserJet III (13 versus 8), the OL820 also has more brains. Thanks to a unique hardware chip designed by Okidata engineers, it instantly solves complex font scaling, type rotation and grayscaling problems "on the fly"—problems the LaserJet has to go back to its software to work out.

So the Okidata OL820 can deliver up to three pages of sophisticated text while the LaserJet III is still thinking about printing its first page. In fact, InfoWorld magazine found the Okidata OL820 to be "the fastest office printer we've tested."

Second paper tray and 4-station workgroup options are available for your Okidata OL820 as well.

The OL840: PostScript From PC To Mac And Back.

If Adobe PostScript® printing is on your menu, the Okidata OL840 offers it for $700 less than a comparably equipped HP. Yet that low list price includes 35 genuine Adobe PostScript fonts, plus 26 bitmapped fonts (4 typefaces); 2 megabytes of installed RAM; plus serial, parallel, and AppleTalk Network® interfaces. You can connect the OL840 to both PC and Macintosh® workstations, and switch between systems instantly.

And the OL840 still leaves you with plenty of options—a second paper tray, extra memory, and a wide selection of additional PostScript fonts on easy-to-install ROM cards.

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*Automatic selection of PC Interf. **Manufacturer's suggested retail price. Dealer price may vary. HP Series, LaserJet, Adobe PostScript, AppleTalk Network, Macintosh are trademarks of their respective corporations. Okidata is a registered trademark of Oki America Inc. Marque déposée de Oki America Inc. Oki OK! is a trademark of Oki Electric Industry LTD. "We don't just design it to work. We design it to work wonders." is a trademark of Oki America Inc. InfoWorld 10/1/91

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CIRCLE 523 ON READER SERVICE CARD

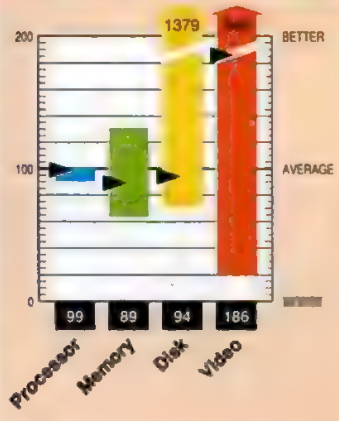
a highly competitive price.

Austin Computer Systems sells computers solely via mail order. The admirable support and service mix includes a one-year parts-and-labor warranty with standard on-site service via General Electric. In addition to a 30-day money-back guarantee, Austin also has toll-free technical support available 7 A.M. to 7 P.M. weekdays in all U.S. time zones and 10 A.M. to 5 P.M. on Saturdays.

It's easy to recommend the Austin Winstation 486/25e if hard disk and video performance is important and you don't mind a limit of five drive bays in a full-sized desktop case. As a power-user's workstation, it's hard to beat this system—though for file server duty it's easy to be tempted by the tangibly better deal available for Austin's 33-MHz 486 EISA machine in a roomier tower case.

BLUE STAR 486/25C

TEST RESULTS



In Short: The Blue Star 486/25c chalked up a good video score but otherwise average performance. Its Diamond Computer SpeedSTAR VGA controller gave the system a second-place video test time. Even though the computer uses 60-ns. RAM, processor and memory results were average. The disk test score was in line with other noncached disk systems. The Blue Star was distinguished by a narrow tower case, seven drive bays, a competitive price, and excellent service and support.

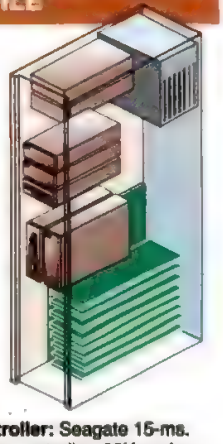
BLUE STAR COMPUTERS INC.

Blue Star 486/25c

by Henry Fersko-Weiss

Blue Star's ISA-bus 486/25c has a narrow, easy-to-carry tower case, seven drive bays, and a brand-name set of components that promises long-term reliability. But what really distinguishes this machine is the thorough testing each unit gets before it leaves the factory, as well as the excellent service and support it gets after. Combine these advantages with a competitive price, and this unit is a good buy.

FACT FILE



Blue Star 486/25c
Blue Star Computers Inc., 2312 Central Ave. N.E., Minneapolis, MN 55418; 800-950-8854, 612-788-7476.
List price (tested configuration): $4,599.
Memory and processor RAM cache: 8MB 60-ns. SIMMs, 128K cache.
Disk drives and controller: Seagate 15-ms. 337MB ESDI; UltraStor controller, 32K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Diamond 1,024 by 768 adapter with 1MB RAM, CTX 14-inch monitor.
Software: DOS 4.01.

CIRCLE 406 ON READER SERVICE CARD

In the standard *PC Magazine* configuration, the 486/25c costs only $3,799. It comes with 8MB RAM, a 128K processor RAM cache, 211MB hard disk, either a 1.2MB or 1.44MB floppy disk, a 1,024- by 768-pixel Super VGA display (with 512K of RAM on the video adapter), and a set of basic shareware programs such as *PC-Calc*, *PC-File*, and *PC-Write*. The machine we tested—which had a 337MB hard disk, 1.2MB and 1.44MB floppy disk drives, and 1MB of RAM on the video card—sells for $4,599. Blue Star offers many options, so it's easy to configure the system the way you want. You can even get a 1.05GB SCSI hard disk, but it will cost you an additional $3,300.

CAPACIOUS

The Blue Star 486/25c is housed in a metal tower case that has a handle on the top for easy mobility. To achieve its slim 6.4-inch width, the 5.25-inch half-height drive bays in the front are turned sideways. The turbo indicator is a large digital display, so there's no question at what speed the computer is running: You can read the numbers from across the room.

Besides the two 5.25-inch drive bays in the front, there are three 3.5-inch bays—all accessible from the front—and two more 5.25-inch half-heights inside. Having all these bays makes it easy to fully load the computer and use it as a file server. Of the eight 16-bit expansion slots, three are occupied with the video, hard disk, and I/O controllers. At present the Blue Star can handle up to 16MB of RAM on the motherboard using 60-nanosecond SIMMs. But thanks to a new Chips and Technologies' chip set that supports 4MB SIMMs, Blue Star plans to upgrade the motherboard's capacity to 64MB.

> One of the main selling points of the 486/25c is Blue Star's use of high-rated, brand-name suppliers, such as AIR and Toshiba.

QUALITY COMPONENTS

One of the main selling points of the 486/25c is Blue Star's use of high-rated, brand-name components. The motherboard comes from AIR and makes use of an AMI BIOS and 60-ns. DRAM SIMM chips. Our test machine came with a Seagate 15-millisecond hard disk and an

UltraStor controller with 32K cache, Toshiba floppy disk drives, and a SpeedSTAR VGA board (which uses the highly rated Tseng chip set) from Diamond Computer Systems. The video board performed superbly on the PC Magazine Labs video benchmark tests, second only to Dyna Micro's ISA system.

Unlike most other manufacturers, Blue Star doesn't build its systems as they are ordered. Instead it keeps various configurations in stock. This lets the company thoroughly test each unit and burn it in for 72 hours—sometimes longer. Blue Star claims this approach minimizes initial system problems and gives Blue Star the opportunity to guarantee same-day shipping if you order before noon.

Blue Star also offers attractive service and support policies. You can return the computer for any reason in the first 30 days and get your money back. If the computer malfunctions during the first 90 days, Blue Star will cover the shipping expense both ways. You get a one-year warranty on all parts and an additional four years on the system parts such as the motherboard. Blue Star pays for labor during the warranty period. The company will send replacement parts for any problem it can diagnose over the phone, assuming you feel comfortable making the change yourself; otherwise it will make the change for you. The company's 20 or so technicians are available 24 hours each day via a toll-free phone line, and specific technicians are assigned to customers as they call in. The only element missing is an on-site service plan.

The only element missing on the Blue Star 486/25c is an on-site service plan.

Given the computer's expandability and narrow-case design, its use of tested brand-name components, respectable performance, thorough testing of units, and excellent follow up service and support, you can't go wrong if you go with this machine—especially since its sticker price is among the most competitive in our test group.

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BOSS TECHNOLOGY CORP.

Boss 486 Model 4625

by Rink Murray

25-MHz 486 tower PCs don't normally make you think of entry-level

computers. But that's how Boss Technology is marketing its ISA-bus Boss 486 Model 4625. With the Model 4625's low list price, rugged construction, brand-name parts, FCC Class B certification, and two-year warranty, this machine will suit almost any user's needs.

For *PC Magazine*'s standard configuration, which includes 8MB RAM, a 1.2MB floppy disk drive, 200MB Maxtor hard disk, and a Super VGA adapter and color monitor, Boss asks a reasonable $5,895. For $100 more, our test unit shipped with an extra 1.44MB TEAC floppy disk drive. Although these prices are not as low as some others in our review group, you may find significant dealer discounts available.

BOSS ROOM

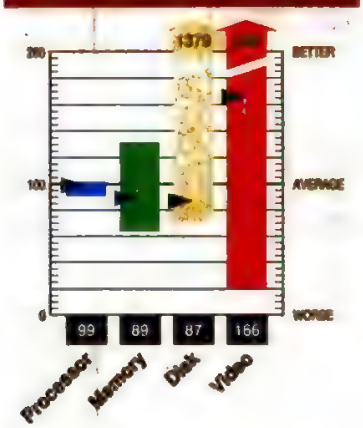
Inside the Model 4625's sturdy 24- by 7.1- by 17.2-inch (HWD) tower case, you will find enough room for six horizontally stacked half-height and two 3.5-inch drive bays. All but the top two half-height drives are accessible from the outside. The motherboard has enough room for 16 1MB SIMM chips and eight 16-bit slots. In our test unit, only two of these slots were occupied: one by the Cardinal Super VGA adapter, the other by the Eastern floppy disk controller.

The Eastern IDE interface card/floppy disk controller supports two serial, one parallel, and one 15-pin game port. The serial and parallel ports attach directly to their corresponding cutout slots on the back of the system, saving slots and space inside the machine. If you want to attach the game port, you must mount it in an expansion slot opening.

At the time we tested the Model 4625, the system had a maximum of 16MB RAM and no external processor cache. Boss says that by the time this article appears, the Model 4625 will include an updated AMI BIOS and a new mother-

BOSS 486 MODEL 4625

TEST RESULTS



In Short: With a low price tag, brand-name parts, and a two-year warranty, the Boss 486 Model 4625 looks like a safe purchase. Yet even with the machine's good video timing, its average processor and memory test scores and below-average disk score, coupled with limited memory expansion and 16-bit processing, make the Model 4625 an entry-level computer. It is adequate for those who use CAD or large spreadsheets but not really suitable as a server.

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InfoWorld's Product of the Year! After outscoring the competition in *InfoWorld*'s 1990 reviews, and being praised as "tops in support and value,"† Elegance 486/25i was awarded the publication's highest honor: Product of the Year. This was the fourth award given to an Elegance 486 system ... no other company comes close!

Elegance 486/25i, Sept. 11, 1990
Elegance 486/33i, Feb. 12, 1991

PC Magazine says "Editors' Choice!" When reviewing 486/25 systems, they said "Only one machine stands out ... you could pay less for a 486 system, but not get the bonuses that are offered with the Elegance."†† In the February 12, 1990 issue, *PC Magazine* declared Elegance 486/33 Editors' Choice, saying the system was "a sure winner in its class."

Computer Shopper readers agree! Elegance 486/25i breezed past the competition and captured a 1990 "Best Buy" award. This makes three years in a row, a Northgate Elegance system was voted tops by *Computer Shopper* readers.

ISA 486 System Features:

- Intel 486/25 or 33 MHz processor
- 4Mb RAM; expandable to 8Mb on motherboard
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- 64K SRAM read/write-back cache
- ISA bus
- One 32-bit, six 16-bit and one 8-bit slots
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- Vertical "Power" case (desktop available)
- 16-bit VGA graphics adaptor with 512K video RAM (expandable to 1Mb)
- 14" SVGA color monitor
- *OmniKey*®/ULTRA keyboard
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- Microsoft® Windows™ 3.0 and mouse
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Compare Elegance 486e performance and Northgate service and support with any other vendor's in the industry. You'll find you can't buy better than Northgate! Call now ... let Northgate build your system today!

True EISA 486 System Features:

- Intel 486/25 or 33 MHz processor
- 4Mb RAM; expandable to 32Mb on motherboard
- 1Mb EISA caching SCSI controller
- 200Mb SCSI hard disk
- 1.2Mb and 1.44Mb floppy drives
- 128K SRAM read/write-back cache
- EISA bus
- Eight 32-bit EISA slots; six bus master and two slave
- One parallel and one serial port
- 16-bit VGA graphics adaptor with 512K video RAM (expandable to 1Mb)
- 14" SVGA monochrome monitor
- Vertical "Power" case
- 300 watt power supply
- *OmniKey*®/ULTRA keyboard
- MS-DOS 4.01 or 3.3 and GW-BASIC software installed
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†*InfoWorld*, July 30, 1990 †† *PC Magazine*, September 11, 1990

Though less than a powerhouse, the Boss is a good entry-level 486 PC.

board, both of which will allow up to 32MB RAM (using 4MB SIMMs) and either a 128K or 256K cache.

The M4625's performance was slightly below average on the 80486 processor tests, partly due to the machine's lack of an external processor RAM cache. The 16-millisecond Maxtor IDE hard disk also performed slightly below average on our DOS File Access test, but the Cardinal 700 Super VGA card finished in the top third in our video tests.

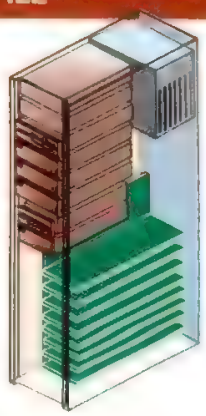
Considering that Boss asks $5,495 and $7,995 for a similarly configured 33-MHz 386 and 486, respectively, the $5,995 test unit is Boss's best value. If you opted for the 33-MHz 486 you could see as much as a 25 percent increase in performance, but the $2,000 difference might not be worth it. On the other hand, a 9 percent price jump from the 33-MHz 386 to the 25-MHz 486 would give you about a 12 percent performance gain.

For users who like to place their tower systems on the floor, Boss also includes a five-foot keyboard extender cable. Another plus is the 300-watt PC Power & Cooling power supply. It features six device connectors, 115/230 switchable voltage, and a knob to let users adjust the speed of the fan.

Since Boss sells through VARs and specialty consultants, you can get the M4625 configured the way you want. However, because of Boss's two-year warranty and on-site service from TRW on all factory-installed parts, many dealers are letting Boss configure the machines itself.

Even though the M4625 is not exactly a performance powerhouse, it does present itself as a good entry-level system. With its two-year warranty, sturdy construction, and reasonable price, the M4625 might make your first foray into 486 computing worth your while.

FACT FILE



Boss 486 Model 4625
Boss Technology Corp., 6050 McDonough Dr., Norcross, GA 30093; 800-628-1787, 404-368-2077.
List price (tested configuration): $5,995.
Memory and processor RAM cache: 8MB 80-ns. SIMMs.
Disk drives and controller: Maxtor 16-ms. 200MB IDE, Eastern controller, 1.2MB and 1.44MB floppy disk drives.
Display: Cardinal Super VGA adapter with 1MB RAM, CTX 14-inch monitor.
Software: DOS 4.01.

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BUS COMPUTER SYSTEMS INC.

Bus 486-25

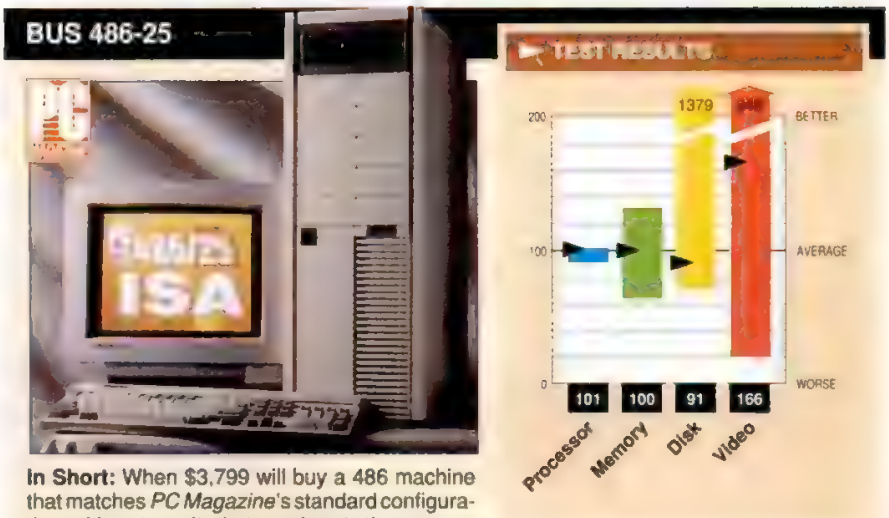
by Greg Pastrick

Home of "Terribly Fast" computers—or so the mail-order company logo states—Bus Computer Systems puts together a 25-MHz 80486 ISA-based system that is competitive enough in performance and cost to be worth considering, even if that system doesn't quite live up to its motto.

With two internal full-height drive bays—one on a swing mount that doubles as a chassis brace—in addition to its five accessible half-height bays, the Bus 486-25 has ample storage capacity and expansion slots inside its tower case for network and high-end applications duty. The prices of its options and features are low, too.

LOW PRICE

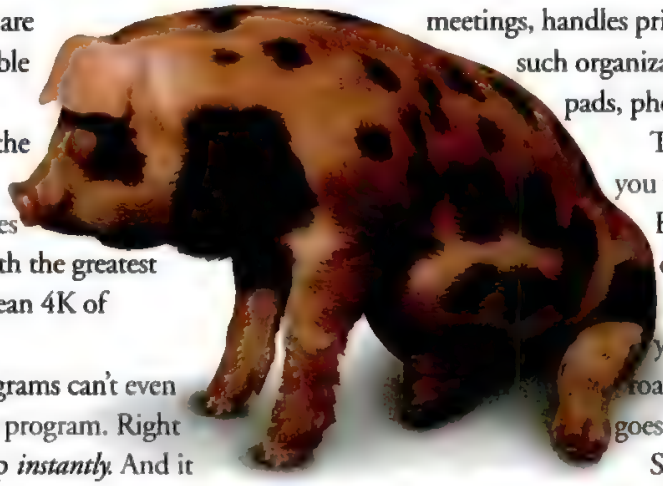
For example, take the $3,799 cost of the Bus system that conforms to our standard configuration. It includes 8MB RAM, 64K of external processor RAM cache, 1.2 and 1.44MB floppy disk drives, a 200MB IDE hard disk, and a VGA display system.



In Short: When $3,799 will buy a 486 machine that matches *PC Magazine*'s standard configuration, with test results that are close to the average of some 60 comparable machines, the Bus 486-25 (a Bus-labeled Micronics system) is certainly worth a look. It has room for seven drives and 16MB of on-board RAM, offering enough computing power for serious network or high-end applications duty. And its warranty and GE on-site service will not leave you in the lurch if the works break down.

For our tests, the system that Bus Computers sent us came with a Super VGA display subsystem and included an NEC MultiSync 3D monitor, a 380MB Maxtor hard disk rated at a 24-millisecond access time, and two TEAC floppy disk drives for a reasonable—though not rock bottom—$5,299.

Buy any other E-mail package and you may get another animal altogether.



Most E-mail programs are slow. Sloppy. And they gobble up lots and lots of RAM.

Right Hand Man II is the brilliantly frugal exception. It pops up instantly. It moves from module to module with the greatest of ease. And it resides in a lean 4K of memory.

For example, most programs can't even access Faxes within another program. Right Hand Man II pops them up *instantly*. And it zooms in and out or turns them right side up just as fast.

Furthermore, Right Hand Man II is the only E-mail program that delivers voice mail, via the Artisoft Sounding Board.

Right Hand Man II also schedules your group meetings, handles printing and equips users with such organizational tools as calendars, note pads, phone books and to-do lists.

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So don't go to market for a big, fat, clumsy E-mail package.

Ask your dealer for a demonstration of Right Hand Man II. Or call 1-800-327-8296 (outside the US, 504-837-1554) to get your 30-day trial copy.

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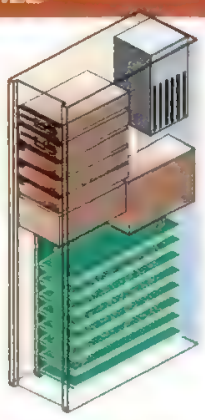

Bus 486-25
Bus Computer Systems Inc., 135 W. 26 St., New York, NY 10001; 800-451-5279, 212-627-4485.
List price (tested configuration): $5,299.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 64K cache.
Disk drives and controller: Maxtor 24-ms. 380MB ESDI, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, NEC 14-inch monitor.
Software: DOS 4.01.

CIRCLE 408 ON READER SERVICE CARD

Based on a Micronics motherboard with a Chips and Technologies chip set and a Phoenix ROM BIOS, the Bus 486-25 allows a maximum of 16MB system RAM using 80-nanosecond SIMMs. The direct-mapped external RAM caching on the processor may be expanded to a maximum of 256K using 25-nanosecond 8K DIPs and 32K DIPs.

STANDARD RESULTS

The Bus 486-25 performed well on the Conventional Memory test and better than average on the Direct to Screen video benchmark test. When compared with other standard ISA systems, its disk test scores, too, were quite satisfactory.

As it stands, the Bus system in its tower configuration is fairly typical of the machines being sold by mail-order outfits these days. Its mix of components corresponds reasonably closely to those found in other PCs. For example, the UltraStor disk controller has been turning up more often, and the Orchid ProDesigner II is another popular component frequently found inside 486 systems. If there is any departure from the ordinary inside this system, the swing mount for an additional drive is about as exciting as it gets. This swing mount has the benefit of adding extra strength to the chassis frame.

Bus Computer Systems offers a one-year warranty on parts and labor for this system, with on-site service backed by GE. Bus also answers technical questions over the phone, but it's your quarter, so prepare your questions before you call.

Price is the standout feature in this Micronics system marketed under the Bus label. This system is in line with other offerings from Bus, such as a similarly configured 486/33 that sells for about $5,000. For less than $4,000, the Bus 486-25 gives you an ample amount of mass storage space and performance close enough to the competition to be a cost-effective purchase, in view of its basically sound quality.

C² MICROSYSTEMS INC.

C² 486-25

by Kellyn S. Betts

If *PC Magazine* were to mete out letter grades to computers, C² would earn straight C's in the performance and innovation categories. Its only ace in the hole would be an assured A in price, helping to offset its other poor grades.

This is not a bad showing when you consider that C² MicroSystem's ISA-bus 486-25 is aimed at the desktop audience. The price tag for this machine, including 128K of processor RAM cache and our standard combination of 8MB RAM, 200MB hard disk, and a Super VGA video subsystem, is $4,200—and that's before any dealer discounts. For this price, you also get *Microsoft Windows* 3.0, a mouse, and a game port added to the C²'s streamlined plastic case. (Our evaluation system also came with a second floppy disk drive—a $75 extra.)

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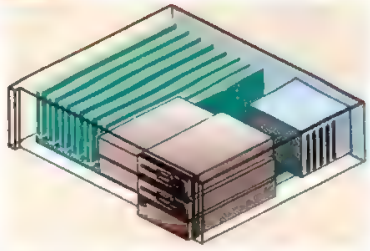


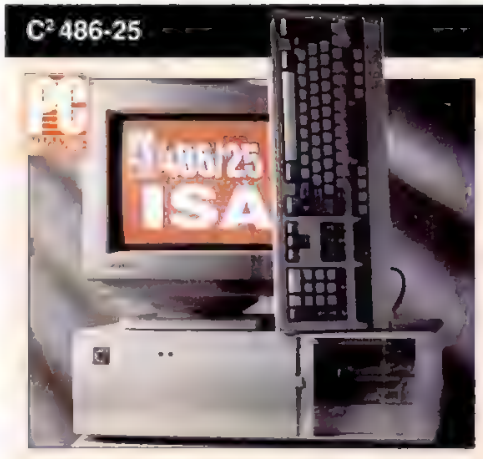
C² 486-25
C² MicroSystems Inc., 47448 Fremont Blvd., Fremont, CA 94538; 415-683-8888.
List price (tested configuration): $4,275.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Conner 16-ms. 202MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: ATI 512K 1,024 by 768 adapter, Artview 13-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

CIRCLE 409 ON READER SERVICE CARD

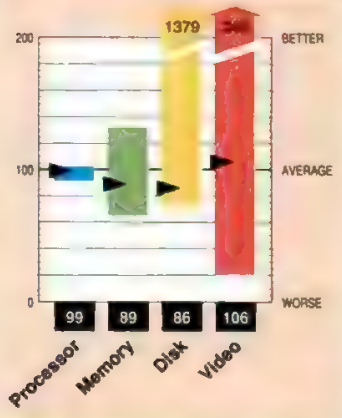
THE 486 ADVANTAGE

If you are concerned that a 486 may be too much computer for you, remember that this price is only $75 more than what C² charges for a 33-MHz 386 with the same components (including a 80387 coprocessor to make it equivalent to the 486) but only a 32MB cache. This represents a 2 percent price jump for as much as a 12 percent performance gain. And it's a lot

C² 486-25



TEST RESULTS



In Short: C² MicroSystems has hit on an attractive combination, especially if price is an important part of your equation. For a pleasant surprise, the system's processor and memory test scores held their own, despite the RAM's placement on a 32-bit expansion card. Unfortunately, disk and video scores fared somewhat worse. The components, drawn from a smorgasbord of options, performed respectably and are priced to sell. The system looks especially good when placed beside a 33-MHz 386.

If you're shopping for a low-cost 486 PC and don't need innovative design or stellar performance, take a look at the C² MicroSystems 486-25.

lower than the premium you'll pay for a known-name 33-MHz 386 with those statistics.

Though it does not sell through the mail, C²'s Sears & Roebuck–like catalog of components includes 80 different components for its direct and dealer customers. Available motherboards span the gamut from 286 ISA to 486 EISA models and can be teamed with a variety of caches, controllers, coprocessors, I/O cards, etc. You can pick what you want. The system we tested came with a Conner 16-millisecond hard disk, an ATI Super VGA video card, and an Artview 13-inch color monitor.

The great equalizer—though no great bonus—among the systems is C²'s warranty: one year for parts, and lifetime labor. This service requires the computer to be shipped back to the manufacturer or to the dealer from whom it was purchased. On-site service with NWC can be bought for an additional 2 percent of the machine's purchase price. Telephone support is available during C² MicroSystems' normal office hours, although users are required to pay the toll.

LOW PRICE, AVERAGE SCORES

Since our tests showed that this 25-MHz 486 performed consistently in the bottom third of our test group, it makes sense for C² to compete on the basis of price. Even so, the C² was close to the best performers on our processor tests, since all were separated by very small amounts.

Where the C² was decidedly average was in its disk, memory, and video test scores. The 80-nanosecond SIMMs reside on a proprietary, 32-bit memory card, which may have hindered its performance. The inclusion of this memory card plus the floppy and I/O controllers left five slots free in the machine we tested; after the hard disk and two floppy disks were installed there was but one half-height bay empty.

If you're shopping for a low-cost desktop 486 computer and don't need innovative design or stellar performance, take a look at the C² MicroSystems 486-25. C²'s large catalog of components and low price may suit your needs.

CHEETAH COMPUTER SYSTEMS

Cheetah Gold 425

by Bill O'Brien

Cheetah System's Gold 425 represents an odd mating of innovative technology, excellent design, and poor service. Considering the system's premium price, Cheetah is scrimping on the one detail that sometimes proves as important as the computer itself.

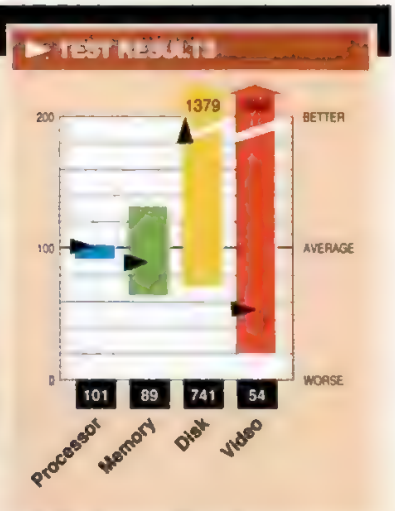
The $10,489 ISA bus machine comes packed with 8MB RAM, a 1.2MB floppy disk drive, a PSI Model 1600 caching disk controller with 512K RAM, a 200MB hard disk, and a Super VGA display system. Our evaluation unit, at $11,388, had a 300MB ESDI hard disk and a second floppy disk drive. A 119-key Northgate OmniKey Ultra with a double set of function keys does keyboard duty. A long tower case houses the electronics, and a 300-watt PC Power & Cooling power supply pumps in more than ample power.

As the larger-than-average capacity power supply indicates, this machine is designed for expansion. The front panel of the 24- by 7.5- by 22.5-inch tower is unusually roomy, allowing space for six externally accessible half-height devices. With two of the bays occupied by the floppy disks, this arrangement still leaves adequate expansion room for tape drives, CD-ROM readers, and whatever additional drives you might choose. Two more half-height bays can be found inside the case; in this installation, they were a haven for the full-sized, 14-millisecond Micropolis ESDI hard disk.

The tower case is unusual for its notable lack of both reset and turbo buttons. Turbo mode is activated or deactivated from the keyboard, while reset duty has been relegated to a secondary function of the keyboard lock. The design can be applauded for its solution to the problem of accidental resets, though it does require you to keep your key either handy or in the lock when you use the Gold 425.

The system's eight ISA bus slots give up three of their number to the I/O card, PSI controller, and Micro Labs VGA card. Physically these slots have an ISA design; electrically they use what Cheetah calls a modified ISA (MISA) bus. This is not the full 32-bit implementation found in EISA bus computers, but the Gold 425 contains a proprietary design termed the bus cycle machine (BCM). Cheetah stresses that the

CHEETAH GOLD



In Short: The Cheetah Gold 425's price covers some radical advances: concurrent I/O addressing and multiple I/O address speeds. A 6-MHz default bus speed was probably responsible for the slow video test result. On the other hand, a caching ISA disk controller with an on-board processor (standard in this system) gave the Cheetah a lightning-fast disk score. Unfortunately, Cheetah misses the mark with its miserly return-to-depot service policy—a real shortfall in an otherwise strong computer.

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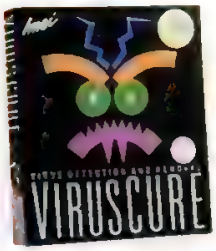

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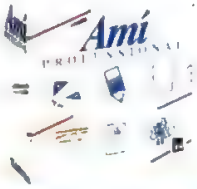

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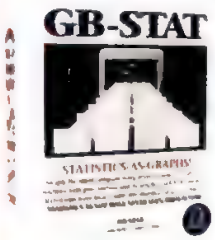

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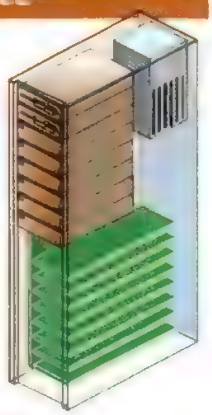

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List price (tested configuration): $11,388.
Memory and processor RAM cache: 8MB 70-ns. SIMMs.
Disk drives and controller: Micropolis 14-ms. 320MB ESDI; Hyperstor controller, 512K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Micro Labs 1,024 by 768 adapter with 1MB RAM, Panasonic 13-inch monitor.
Software: DOS 4.01, *Windows* 3.0 with mouse.

CIRCLE 410 ON READER SERVICE CARD

importance of this BCM lies in two areas: First, it allows concurrent I/O processing during write operations; second, within the confines of the BCM, 32-bit operations are performed and then parsed out in 16-bit or 8-bit segments as the bus device requires.

Also indicative of the Gold 425's rugged individualism is its 6-MHz base bus speed. Cheetah maintains this level to accommodate older boards and cards and claims there is no actual difference in data acquisition performance between 6 MHz and 8 MHz.

For the skeptical among us, higher bus speed options are available, but here too there is nothing ordinary about the Gold 425. Typically, bus speed options are mutually exclusive; by rights they must be because it is impossible to operate separate (and different) speeds simultaneously along the same electrical bus. Cheetah gets around this by allowing the device using the bus to, in effect, determine its own speed. The company uses another proprietary technology, which it calls Hot Cycle Architecture, to associate a given address range with a specific I/O speed and apply that speed when the I/O address is selected. Each card plugged into the bus has a unique address, and the Gold 425 can handle up to four I/O addresses running at anywhere from the manufacturers' recommended I/O speed up to the full clock speed of the CPU. The BCM takes care of determining when each address can use the bus.

Despite its far-flung capabilities, the machine sent to *PC Magazine* implemented only the 6-MHz I/O speed. This fact may not be apparent from the above-average processor and cached disk scores (it was the only ISA machine we tested with a caching controller because Cheetah designed it to be used with this card at all times), but it is painfully obvious in the timed video test results.

With all of this advanced technology, it is no wonder that the Gold 425 carries a price tag as good as its name. Unfortunately, compared with the futuristic architecture of its machines, Cheetah's service policy is practically paleolithic. The Gold 425 carries a one-year warranty on parts and labor; users must return the entire system to Cheetah for repair. In some cases, if Cheetah deems you qualified, it will cross-ship you replacement parts. Considering the machine's cost, that policy should not be acceptable. Minimally, on-site back-up service—an option that even discount vendors provide—should be offered.

If your applications can take advantage of the performance features of the Gold 425, the system is certainly worth its price. But the service policy mismatched with this otherwise premium machine should give you pause before you decide to make a commitment.

CLUB AMERICAN TECHNOLOGIES INC.

Club 486 Hawk II

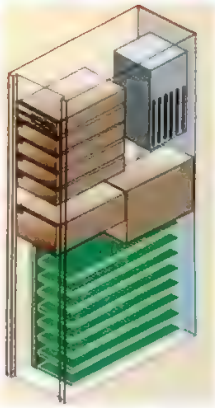
by John R. Quain

The 486 Hawk II is Club's 25-MHz version of its 33-MHz Hawk IIITi, which garnered the Editors' Choice nod in the February 12, 1991, issue of *PC Magazine*. The system is also an update of the Club Hawk II we reviewed in our September 11, 1990, review of 25-MHz 486s.

With this system, Club AT redesigned the old 25-MHz system's ISA motherboard and repackaged the system in the spacious tower case it began offering with the 33-MHz Club Hawk IIITi.

Wisely, the company has not attempted to fix what isn't broken. We were pleased to see that Club offers choice components in its 25-MHz system, even though we did find that the Hawk II didn't compete as well as its 33-MHz sibling in this round of

FACT FILE



Club 486 Hawk II
Club American Technologies Inc., 3401 W. Warren Ave., Fremont, CA 94539; 415-683-6688.
List price (tested configuration): $3,995.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 64K cache.
Disk drives and controller: Maxtor 14-ms. 338MB ESDI, Data Technologies controller, 1.2MB floppy disk drive.
Display: Genesis 256K 1,024 by 768 adapter, Club 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0 with mouse.

CIRCLE 411 ON READER SERVICE CARD

PC Magazine Labs tests. Despite its respectable showing, many of the Hawk II's rivals managed to exceed its performance.

For $3,995, you'll find many of the same components and parts in the Hawk II as in the $5,170 Hawk IIITi. Club AT's tower case, for instance, has five accessible half-height drive bays for floppy disk or tape drives and two full-height internal bays for hard disks. The 338MB Maxtor hard disk and 1.2MB TEAC floppy disk drive in our test system enjoyed the convenience of quick-release drive racks for service or repair. In addition, our standard configuration came with 8MB of RAM, DOS 4.01, *Windows* 3.0, a serial Microsoft mouse, and an AMI BIOS. Video and system BIOS shadowing are included. Beware, though: You won't be able to disable this feature, which may cause problems if you have memory conflicts.

The Hawk II's Club motherboard has the same 64K of 20-nanosecond discrete external SRAM cache as the Hawk IIITi. If you think you need more, the cache can be expanded to 256K, but increasing the cache in this case may deliver diminishing returns. In our processor tests, the Hawk II ran with the very top machines. Club also has maintained the IIITi's 70-ns. speed for the 1MB SIMMs on the Hawk II's system board, where many vendors have fallen back to 80-ns. RAM.

Aside from a slower processor, what

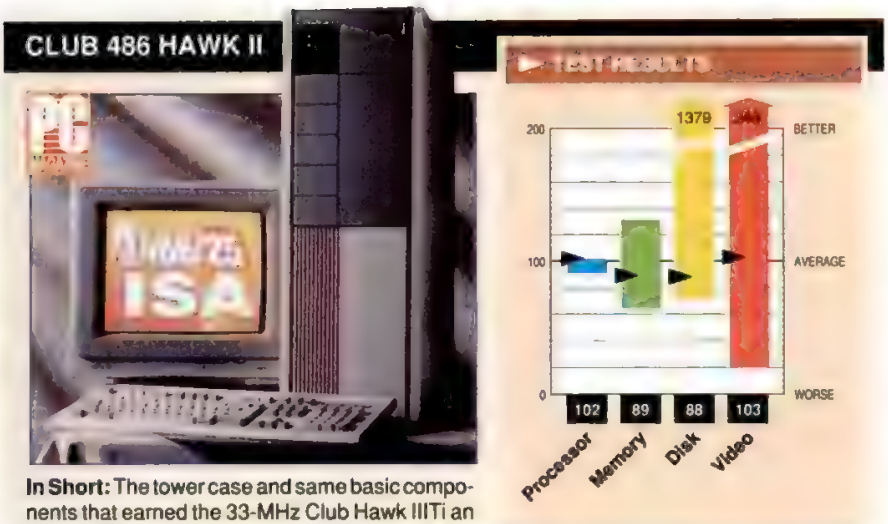
Quick, do you know the first name in microprocessors?

_____ 486™

_____ 386

_____ 386SX™

CLUB 486 HAWK II



In Short: The tower case and same basic components that earned the 33-MHz Club Hawk IIITi an Editors' Choice (February 12, 1991) keep the Club 486 Hawk II in good standing in the 25-MHz crowd. Some changes—and the improved performance of its competitors—kept it from receiving top honors on our tests this time around; both disk and video test results were slower than those of many of the Club model's speedy competitors. But the Hawk II still flies in the top half of this group.

makes the Hawk II different from its 33-MHz sibling? Though the Hawk II uses the same Maxtor hard disk as the Club Hawk IIITi, the UltraStor controller card has been replaced with an integrated floppy/hard disk ESDI controller from Data Technologies. It contains only a 32K buffer—just enough to run with the other ISA systems in this review.

The video subsystem relies on the Genesis Rainbow 4000 1,024- by 768-pixel card armed with a Tseng Laboratories chip set and 256K of on-board DRAM. It placed the Hawk II in the middle of the pack. CAD users should also note that the 14-inch, 0.28-dot-pitch monitor that Club includes with the system won't make full use of the 1,024-by-768 card: The monitor's maximum noninterlaced capacity is 800 by 600 pixels.

CLEAN LINES

Club AT paid close attention to this system's construction and assembly. I/O connections are strung off the motherboard to cutouts in the back of the case to save the machine an expansion slot. In addition, the ports can be disabled to accommodate future upgrades. All connections on the back are clearly labeled, and if you open the side of the spacious metal case you'll find fans, top and bottom, for component-saving ventilation. Moreover, you won't find any dangling cables or connectors; everything is neatly tucked away and tied down.

> Club AT paid close attention to the Hawk II's construction and assembly. You won't find any dangling cables; everything is neatly tucked away.

There are only a couple of minor elements you might find disappointing. The first is the Hawk II's AT-style keyboard, which has almost no travel or life in its keys. Currently, it's the only 101-key keyboard that the vendor offers, so you may want to make an extra cash outlay for another keyboard.

The second note to keep in mind is that Club no longer has a toll-free technical support line. In its favor, the Club Hawk II comes with logically organized system documentation, standard one-year parts-and-labor coverage, and on-site service supplied through GE. But the FCC Class B certification should also bolster user confidence, especially since only three sub-$5,000 systems in this roundup have this distinction.

Despite continuing price declines, a comparably outfitted 33-MHz 486 system from Club will still cost you around $1,200 more than the 25-MHz model reviewed here. For most applications, we think that's too much to ask for the small boost in performance you'll get out of the faster 486. If you must save money, you can reduce your exposure by $800 and pick up the company's 386/33 system.

COMPUTER MARKET PLACE INC.

Ultra 486

by John R. Quain

If you're the sort of person who has the patience to read the ingredients lists on cereal boxes, you're probably also the type of person who wants to know exactly what components go into your computer. Pennsylvania mail-order vendor Computer Market Place caters to just such fastidious personalities by allowing the buyer to decide what's installed in individual machines. Not only will CMP give you a very competitive price, but you'll get exactly the components you want.

Computer Market Place will deliver a 25-MHz 486 system that conforms to *PC Magazine*'s standard configuration for a mere $3,976. The system we tested arrived in an enhanced tower case and included 8MB RAM, a 208MB IDE Seagate hard disk, both a TEAC 1.2MB and a 1.44MB floppy disk drive, a Super VGA adapter, and a 14-inch monitor. It was priced at $4,449, making it one of the most reasonable 486s in this roundup.

GIVE AND TAKE

However, you have to give up something for such price competitiveness and pick-and-choose advantages. The accompanying documentation, for example, consists of only the technical manuals, and the Cache Computers motherboard (which contains an OPTi chip set that allows you to switch bus speeds from 8.3 MHz to 6.3 MHz or 12.5 MHz) cannot accommodate a Weitek 4167 coprocessor. Consequently, those considering a 486 machine for CAD applications requiring Weitek assistance will be disappointed. Moreover, if you need a speedy file server, you won't exactly be knocked off your network manager's chair by unsurpassed speed.

The Ultra 486 turned in about average

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CIRCLE 521 ON READER SERVICE CARD

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Display	*VGA Sidelit CCFT* *Paper White VGA LCD* *256KB Video RAM* *64 grey shades support*	*VGA Edgelit LCD* *16 grey shades support*
Keyboard	*Standard AT-compatible* *3mm key travel depth*	*Enhanced keyboard* *2.5mm key travel depth*
Memory	*1MB expandable to 5MB*	*2 MB expandable to 10MB*
Software Incl.	*Laplink III* *MS-DOS* *Windows 3.0*	*Not available*
Support	*Toll-free 800 number* *On-line modem support*	*Not available*
Price	*20MB - $3999* *40MB - $4499*	*30MB - $6499* *60MB - $6999*

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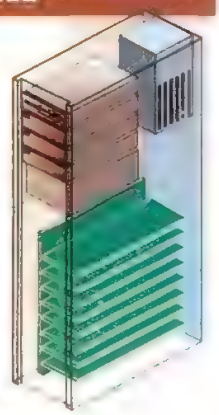


Ultra 486
Computer Market Place Inc., 450 Pkwy. #202, Broomall, PA 19008; 800-545-7397, 215-359-0750.
List price (tested configuration): $4,449.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 128K cache.
Disk drives and controller: Seagate 15-ms. 208MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, NEC 14-inch monitor.
Software: DOS 4.01.

CIRCLE 412 ON READER SERVICE CARD

performance overall. The 128K of 30-nanosecond RAM cache helped the processor keep up with this group but provided no significant gains. Our tests did turn in good Conventional Memory scores—mainly attributable to the 70-ns. SIMMs. Video scores, as one might expect, benefited from the Ultra's Orchid Prodesigner II Super VGA card: the Ultra 486 tied for third in this group.

If price is your main consideration, however, the Ultra 486 will satisfy most requirements. The tower case of the system we tested had a total of four half-height drive bays (all accessible) and one internal full-height drive bay. The motherboard allows for 16MB of RAM and sports five open expansion slots. The Ultra was solidly constructed; bolted to its chassis was a 220-watt PC Power & Cooling uninterruptible power supply that gave added reassurance. PC Power & Cooling claims 5 to 10 minutes of task completion time for that UPS after the rest of your equipment succumbs to power outages—a plus, particularly in the server environment.

EXTENSIVE OPTIONS

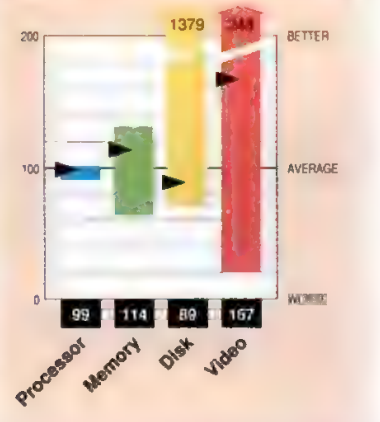
Of particular interest from Computer Market Place's extensive price and options list is the 130-key Focus keyboard that arrived with our system. The keyboard features a built-in calculator with an 8-digit LCD panel, duplicate function keys along the side and the top, and a turbo key.

And that's just an inkling of the options available. If you start to compare systems, an identically configured Computer Market Place 33-MHz 386 (in *PC Magazine*'s standard configuration) is $3,291, and a 33-MHz 486 model is $4,399. For a significant improvement in processor speed—as much as 25 percent—the 33-MHz 486 model is worth considering over the 25-MHz model. But if you feel recessional budget constraints, the 386 offering is definitely a deal.

In an effort to assuage buyer's fears of ordering by mail, Computer Market Place gives you a 60-day money-back guarantee. The company also provides a two-year parts-and-labor warranty on the memory and motherboard, with one-year coverage on the rest of the system. There's no on-site service available, but you can reach CMP via its toll-free telephone number, backed up by overnight parts shipping. All in all, this type of service makes a persuasive argument for mail-order purchasing.

ULTRA 486

TEST RESULTS



In Short: The Ultra 486 turned in average performance. The 128K of 30-ns. RAM cache provided no significant gains, though the ISA machine, with its 70-ns. RAM, did turn in a good memory test score. The video score excelled, thanks to the Orchid ProDesigner II card. A mail-order outfit, Computer Market Place offers some attractive options for the buyer who knows what should go into a PC. But if you need extensive documentation and some hand-holding, you probably won't be comfortable.

COPAM USA INC.

Copam 486/25 EISA

by Bill O'Brien

There are only two surprises to be found in the Copam 486/25 EISA computer. While those two alone might make it worth its price of admission, you'll need to determine just what Copam plans for this high-performance machine before you decide to pay the not-inconsiderable entry fee.

At $8,779 (including a 200MB hard disk), this EISA computer is certainly not the most expensive in the group, but it can hardly masquerade as anything but a high-ticket item. Granted, the $9,279 machine we tested performed extremely well in our tests, and the price includes premium components—8MB of RAM, a 380MB ESDI hard disk mated to a Mylex bus-mastering controller (with an on-board processor and 1MB of cache), and a Super VGA system. However, it also lacks a few important components.

While it's positioned as a medium-sized network server, the system lacks any secondary processor RAM cache. For single-user DOS environments, the primary 8K of cache in the 80486 would be acceptable even though 32K of secondary cache would be preferable. But under the high processor and RAM demands of networking, some secondary cache is beneficial, and there's none to be found here.

TOWER...OR SIDEWAYS DESKTOP?

Likewise, the Copam tower enclosure is no more than a standard AT box turned on its side. The design of the box accounts for two banks of adjacent half-height drives: three in one bank and two in the other. Remove one half-height bay for the single floppy disk installed and one full-height bay for the 380MB hard disk, and what's left is hardly sufficient for the tape drive

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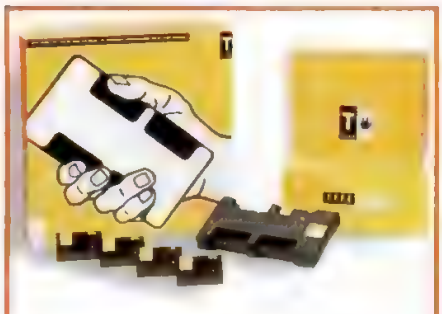

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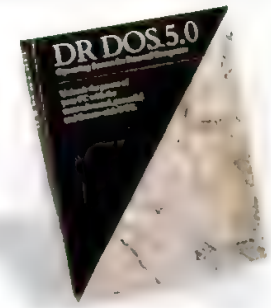

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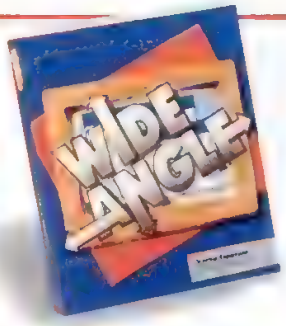

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4131 ▣Agenda 2.0 . . . . . 299.
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2798 ☐Managing Your Money 7.0 . . . . . 139.
Micro Logic ... NCP
6787 ▣Info Select 1.1 . . . . . 95.
Microcom ... NCP
7649 ▣Virex-PC 1.1 . . . . . 79.
6234 ☐CarbonCopy Plus 5.2 . . . . . 119.

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7010 ☐Windows 3.0 99
7388 ▣Project 1.0 for Windows 459
7882 ☐Productivity Pack 1.0 for Windows 45
2904 ☐Works 2.0 . . . . . 99.
2901 ☐Word 5.5 . . . . . 209.
7387 ▣PowerPoint 2.0 for Windows 329
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2856 ▣Excel 3.0 for Windows 329
8137 ▣Office for Windows *(includes Excel, Word for Windows, and PowerPoint)* . . . . 659.
2853 ▣C Compiler 6.0 . . . . . 329.

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2982 ▣WillMaker 4.0 . . . . . 39.
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9879 ▣ReadRight 2.01 . . . . . 309.
9878 ▣ReadRight 3.0 for Windows 309
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4586 ☐DESQView 386 2.3 . . . . . 145.
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Samna ... NCP
5799 ▣Ami Pro 1.2 . . . . . 309.
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9638 ☐Professional Write Plus 1.0 175
3482 ☐Harvard Graphics 2.3 ..... 329.
9490 ▣Harvard GeoGraphics ..... 269.
Software Toolworks ... NCP
9859 ▣Word for Word *(Windows version)* 47
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7977 ☐Brief 3.1 *(Programmer's Editor)* ..... 189.
8915 ☐Sourcerer's Apprentice 1.0 ..... 379.
Spinnaker ... NCP
3478 ☐PFS:First Choice 3.1 ..... 105.
7604 ▣PLUS for Windows 1.0 ..... 289.
Symantec ... NCP
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3425 ☐Q&A 3.0 ..... 239.
7999 ▣Norton Anti-Virus 1.0 ..... 89.
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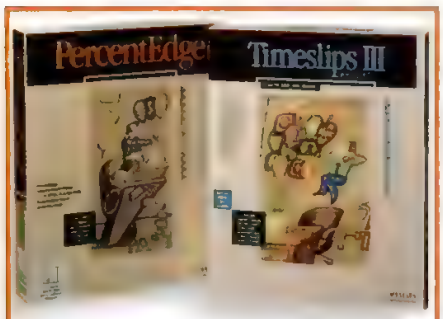

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3804 ☐WordPerfect 5.1 ..... 265.
6685 ▣DrawPerfect 1.1 ..... 279.
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6791 ☐WordStar Prof. 6.0 ..... 219.
XTREE ... NCP
6161 ▣XTree Gold 2.0 ..... 95.

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8886 ▣SimEarth ..... 45.
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7865 ☐PGA Golf ..... 35.

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8136 Running Microsoft Excel 22
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Software Toolworks ... NCP
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3467 ▣Tetris ..... 22.
Stone & Associates ... NCP
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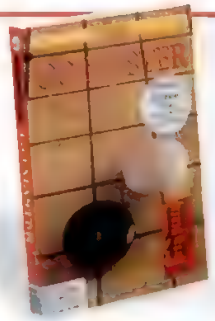
7564 ▣Young Math 2.2 ..... 22.



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7105 Smart UPS 600LS ..... 469.
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9038 BJ-330 Printer *(136 column)* ..... 649.
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9876 83D87-33 ..... 459.
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1930 LQ-850 *(80 col., 264 cps, 24 pin)* ..... call
1917 LQ-1050 *(136 col., 264 cps, 24 pin)* ..... call
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9034 33 MHz 386 Motherboard for AT ..... 1399.

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4696 2400B Internal Modem ..... 149.
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6420 2400EX MNP Modem ..... 229.
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5342 Above Board Plus 8 I/O 2 Meg ..... 569.
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7975 ScanMan 256 ..... 319.
8694 MouseMan *(serial)* ..... 69.
9766 MouseMan *(cordless)* ..... 139.

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7595 2 Meg Expansion for HP LaserJet IIP or III ..... 129.
7012 Memory Upgrade PS/2 70 - 2 Meg ..... 149.

Microsoft ... lifetime
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2897 Mouse with Paintbrush ..... 105.
2898 Mouse with Windows 3.0 ..... 149.

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5085 Multisync 3D Monitor ..... 689.

Orchid Technologies ... 4 years
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9833 PacificPage XL *(includes high speed accelerator board)* ..... 799.

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3102 2400 Baud External Modem ..... 179.
8993 2400 Baud Internal Modem *(V.42 bis)* .. 169.
8994 2400 Baud External Modem *(V.42 bis)* .. 209.
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6797 TheComplete Fax Portable ..... 319.
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9758 TheComplete Flatbed Scanner ..... 995.
9760 TheComplete Page Scanner with Calera's Word Scan ..... 619.
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9893 T2000SX Notebook *(40 Meg)* ..... call
9894 T1200XE Laptop *(40 Meg)* ..... call
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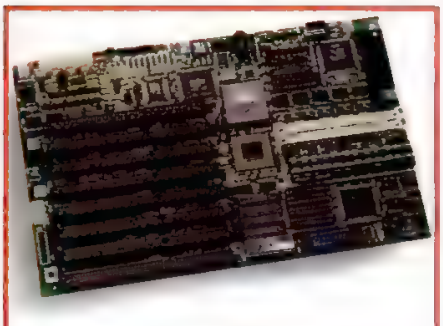
8105 Installation Kit for Standard Bus ..... 95.
8106 Installation Kit for Microchannel ..... 249.



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2500 PC2B Controller ..... 209.
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5010 1.2 Meg External *(for PS/2's)* ..... 215.
6602 1.44 Meg External *(for PC/XT/AT)* ..... 239.
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3297 3½" DS/DD 720k Diskettes *(Qty. 10)* .... 12.
3298 3½" DS/HD 1.44Mb Diskettes *(Qty. 10)* .. 19.
6148 3½" DS/DD *(3 Pack)* ..... 29.
6375 3½" DS/HD *(3 Pack)* ..... 49.
8185 QD 2040 Tape Cartridge ..... 19.
3M ... lifetime
3943 DC 2000 Tape Cartridge ..... 20.
6065 DC 2080 Tape Cartridge ..... 25.
3944 DC 600 Tape Cartridge ..... 29.
5679 DC 6150 Tape Cartridge ..... 29.

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7813 256k x 4 Chips ..... call

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PC Conservation.

Our favorite multiuser environment.
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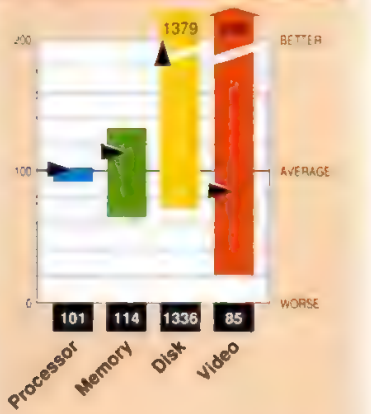
COPAM 486/25 EISA

TEST RESULTS

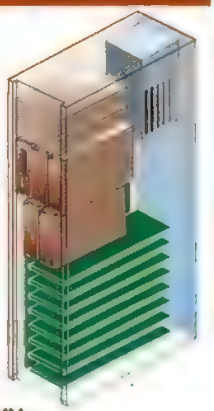


In Short: While the Copam 486/25 EISA has high quality, it suffers a bit of an identity crisis. The relatively high system price and implied intent of the EISA environment for networking do not mate well with a decidedly single-user case design and monitor. Meanwhile, the sterling performance of the ESDI hard disk and caching controller (with its on-board processor) makes a good case for file-server duty. The computer would be a winner if it focused on either market, but it is difficult to recommend as it is.

and secondary internal hard disk that most medium-sized networks eventually demand.

The motherboard is also puzzling. It's definitely EISA by design, but Copam has substituted two 16-bit ISA slots in an otherwise EISA-only environment. The assumption, of course, is that the selection of ISA cards is much greater than that of their EISA counterparts. This is especially true of video boards—which is what one of the ISA slots has been filled with.

FACT FILE



Copam 486/25 EISA
Copam USA Inc., 45875 Northport Loop East, Fremont, CA 94538; 800-828-4200.
List price (tested configuration): $9,279.
Memory and processor RAM cache: 8MB 80-ns. SIMMs.
Disk drives and controller: Maxtor 15-ms. 340MB SCSI; Mylex controller, 1MB cache; 1.2MB floppy disk drive.
Display: Headland 512K 1,024 by 768 controller, Copam low-radiation monitor.
Software: DOS 4.01.

CIRCLE 413 ON READER SERVICE CARD

But though ISA cards work equally as well in EISA slots, the Headland video board included in this system didn't perform as well as the computer's other components. And the net result for the machine as a whole is that while you are paying an EISA price for the computer, you're receiving only 75 percent of the EISA expansion capability.

You can't suggest that Copam attempted to foist a quickly patched together, haphazard design on its buyers (though we finally dropped the vendor's ISA counterpart from this roundup because of Copam's inability to provide us with a working production model for testing). FCC records leading up to the Class B grant indicate that the machine was submitted five months prior to this review. With three of those months occupied by the FCC's certification process, it's fairly obvious that the motherboard was intended to be that way.

LOW-RADIATION MONITOR

One of this machine's surprises is connected to the other end of the video cable. Copam is one of the first vendors to supply a low-radiation monitor with its system. The 14-inch ICCM monitor claims resolution as high as that of an IBM 8514A and sports a host of user controls. More important, its inclusion shows that Copam is responding to current concerns over excessive emission. But it compounds the mystery because a monitor such as this would be ideal for a single-user installation, while EISA environments are ideal for multiuser conditions.

The second surprise is a delight. Copam's warranty is fairly standard: One year parts and labor. However, it's not implemented by some phone arrangement with parts shipping coupled to an obscure promise for on-site backup. Instead, the warranty is enforced on-site only, through TRW. If you own a Copam system, the only time your hand will approach the back panel is if the phone you use to call Copam to report a problem happens to be near it. That level of service is certainly commensurate with the premium price the computer commands.

Copam USA is a part of a much larger company, Copam Electronics of Taipei, and this parent company is arguably one of the bigger players in the offshore PC market. It's hard to believe that the company would offer a machine it considered poorly designed. But intentional as the design may be—and despite the machine's stellar performance on all our tests save those exercising video—it's difficult to recommend Copam's 486/25 EISA. We counsel waiting until it's been refined as either a single-user station or a network file server.

CSS LABORATORIES INC.

CSS MaxSys 486 MTE/25

by Greg Pastrick

Big computing usually comes in big packages, and if you're lucky the machine has wheels. True to its promise, the CSS MaxSys 486 MTE/25 gives you plenty of elbow room: There's no shortage of big expansion possibilities in this 12-slot EISA tower from CSS Laboratories.

The same holds true for memory expansion: A maximum of 64MB is allowed on its 32-bit proprietary card. As you might expect, this expandability comes at a price. In this case it's $10,962 for a system setup matching our standard configuration, which includes 8MB of RAM, a 383MB SCSI hard disk, 1.2MB floppy disk drive, 8K of internal processor caching memory, a Super VGA display system, and DOS 4.01.

With such potential, the expectation is that the performance will match the promise. Stacked against the 29 units tested in

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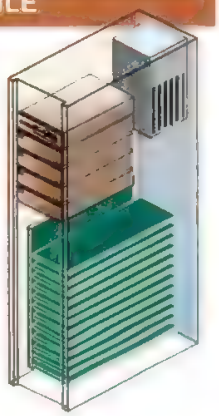


CSS MaxSys 486 MTE/25
CSS Laboratories Inc., 1641 McGaw Ave., Irvine, CA 92714; 800-966-2771, 714-852-8161.
List price (tested configuration): $10,962.
Memory and processor RAM cache: 8MB 80-ns. SIMMs.
Disk drives and controller: Micropolis 15-ms. 340MB SCSI, Adaptec controller, 1.2MB floppy disk drive.
Display: Western Digital 1,024 by 768 adapter with 1MB RAM, NEC 14-inch monitor.
Software: DOS 4.01.

CIRCLE 414 ON READER SERVICE CARD

this roundup, however, the MaxSys test results fall slightly below the middle. Comparative testing on the MaxSys 486 MTE/25's Micropolis hard disk and Adaptec controller shows the system to be a competitive performer among EISA PCs with uncached controllers. But direct screen access times from the Western Digital video interface with Paradise chip set are decidedly bottom-rung. The 80486 Instruction Mix test time is roughly average for the group.

Are the options and features enough to make up for the deficit? Maybe so. CSS offers a list of IMP ESDI and SCSI drives from 106MB to 1.2GB priced from $1,300 to $6,900 as alternatives to the Micropolis drive shipped with this test unit, as well as controller card options from Adaptec. CSS also offers TEAC floppy disk drives. The lack of external processor caching will be addressed by the company's release of a 128K cache controller card (not available for this review) to fill the open socket on the CSS-manufactured motherboard. What's more, CSS offers 25-MHz 486-based systems in five and ten half-height bay towers with both ISA and EISA bus designs.

The bus speed for this EISA is 8 MHz, and BIOS operation is handled by Award ROMs. On initial inspection, the motherboard was found to hold four evaluation-system ROMs, but CSS sent replacements that we installed before testing. Despite the five filled slots on the motherboard, the Intel chip set, two EISA controllers, and an open Weitek numeric processor socket are plainly visible and accessible. Even with I/O, SCSI interface, floppy disk controller, display, and memory cards installed, seven slots remain open for use with other CSS options such as Ethernet cards.

As reviewed, the MaxSys came with a NEC MultiSync 3D monitor and a mediocre AT-style SeJin keyboard. The company lists no other keyboard options but offers a Goldstar 14-inch VGA monitor and a 16-bit Video-7 VGA card.

CSS backs its systems with a generous 18-month warranty on all CSS-brand components. Purchase of any unit includes one year of free on-site service. Matched against other EISA systems, the most outstanding feature of the CSS MaxSys 486 MTE/25 is its facility for hearty expansion.

DATAWORLD INC.

Dataworld Data 486-25

by Bruce Brown

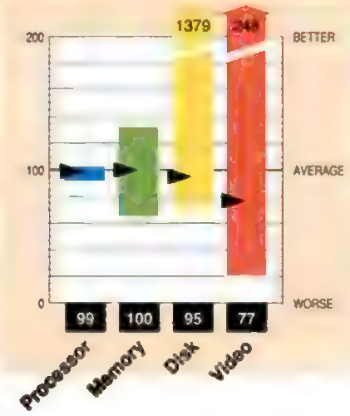
Any computer with an FCC Class B rating in a category where many mail-order vendors are satisfied to do without is a standout. Dataworld's Data 486-25 is such a system. While the Data 486-25 is for the most part an average performer in this category and the system's price ranges from average to just a bit high for comparable mail-order systems, Dataworld's strong service and support mix and the computer's FCC Class B certification combine to earn this machine a hearty recommendation.

You'll hardly feel the price difference for the radio-frequency shielding: In its full size, AT-style desktop case, the Dataworld Data 486-25 costs $4,545 with 8MB RAM, a 210MB 19-millisecond Connor IDE hard disk, a 1,024- by 768-pixel video card, and an 0.28-mm. dot-pitch Super VGA color monitor.

The Data 486-25 uses Dataworld's own

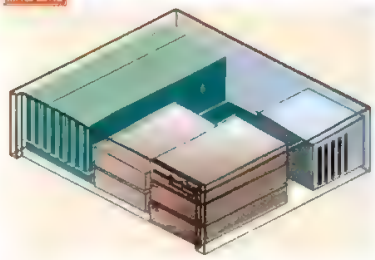
MAXSYS 486 MTE/25

TEST RESULTS



In Short: With a Micropolis hard disk and Adaptec controller, the spacious CSS MaxSys 486 MTE/25 turned in a disk test score just slightly lower than average for uncached systems. Our test of the Western Digital video card with Paradise chip set showed lower-than-average performance as well. In its favor, this 25-MHz EISA system has lots of expansion potential in its tower version. It is backed by an 18-month warranty on all CSS components, and the company gives a year of free on-site service.

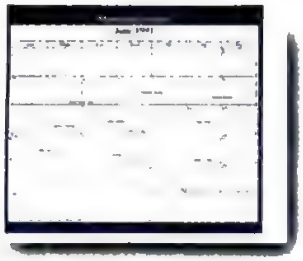
FACT FILE



Dataworld Data 486-25
Dataworld Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660-1404; 800-736-3282, 213-695-3777.
List price (tested configuration): $4,545.
Memory and processor RAM cache: 8MB 80-ns. SIPs.
Disk drives and controller: Conner 19-ms. 210MB IDE, 1.2MB floppy disk drive.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Viewsonic 14-inch monitor.
Software: DOS 4.01.

CIRCLE 415 ON READER SERVICE CARD

NIGHT OF THE LIVING DEADLINES.



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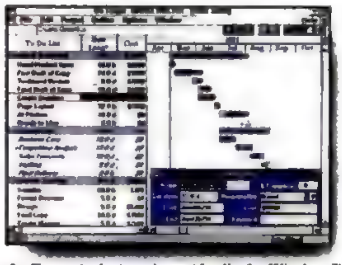

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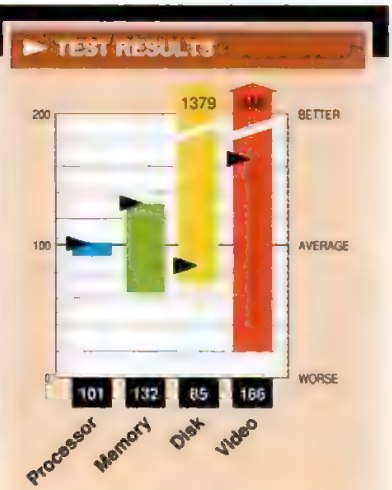
DATA 486-25



In Short: The Dataworld Data 486-25 garnered some high test scores but faltered on disk performance (though its score was reasonable compared with those of other noncached ISA disk drives). The 80-ns. SIP RAM produced a first-place memory score, and the speedy video timing reflected good implementation of the Orchid ProDesigner II video card, yet the system's FCC Class B rating and Dataworld's service and support policies make this a machine to consider.

> The Data 486-25's performance was quite respectable for its class.

motherboard design with an OPTi chip set and an AMI BIOS. While the OPTi chips have built-in support of external RAM cache circuitry, an external cache RAM was not included on the system we tested. The company does offer a 128K cache option, which comes on a board that fits in a proprietary 32-bit slot, but the $350 price tag may not buy you much over what you get from the 486's internal 8K cache. A second 32-bit slot is used for memory expansion beyond the motherboard's limit of 8MB.

Besides the two 32-bit slots, the Data 486-25 has six 16-bit ISA expansion slots. The test system's video card plus its combination floppy disk drive controller and I/O card left six free slots. The full-size desktop case has the usual five half-height drive bays, three of which are capable of using drives with removable media.

The use of the premium Orchid video card served Dataworld well, giving the machine above-average video scores on PC Magazine Labs benchmark tests. In our other tests, as well, the Data 486-25 performance was a notch above average—quite respectable, for this class.

The Data 486-25 compares well in price against the company's 386/33 machine which, similarly equipped, costs $4,105. The price difference is not much more than it would take to add a 25-MHz 80387 math coprocessor to the 33-MHz 386, so buying the 486 with internal cache and internal math coprocessing is worth the money.

Compared with its mail-order peers in terms of price, the Data 486-25 is midrange. It is a bit more expensive than comparable machines from ACMA Computers and Micro Express, about the same as a similar machine from Austin Computer Systems, and less than one from Dell. In each case these systems would have roughly comparable performance and expansion room.

Like many other mail-order houses, Dataworld has a robust set of service and support policies. These include standard on-site service via TRW to back up the one-year parts-and-labor warranty, toll-free technical support, and a 30-day money-back guarantee. The company sells only through mail and telephone orders.

If you're looking for a high-powered workstation for home or for an electrically crowded desk, the Data 486-25 is a solid, reasonably priced bet.

DELL COMPUTER CORP.

Dell System 425TE

by Alfred Poor

The value of a computer system is determined by more than just raw speed. While it may not satisfy those with a lust for more MIPS, others will find the new EISA-based Dell System 425TE an attractive alternative in the 486-25 market.

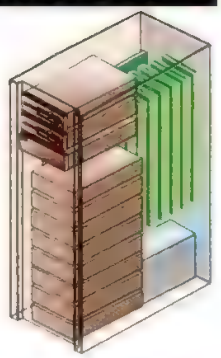
The 425TE carries a list price higher than that of a low-end clone but considerably lower than that of top-tier products like Compaq and IBM. At $7,818 for *PC Magazine*'s standard configuration—8MB RAM, 190MB ESDI hard disk, color Super VGA display, and DOS 4.01—it is a mid-priced competitor. Our tested version had a 320MB hard disk and a second floppy disk drive, bringing the total price to $8,717.

These prices are reasonable compared with the rest of Dell's high-end lineup. Dell's 433TE, the 33-MHz version that includes an external RAM cache, goes for nearly $2,000 more. The ISA-based desktop 333D offers a 33-MHz 386 with system cache performance for about $3,000 less in a similar configuration.

NO CACHE, LOTS OF FLASH

The 425TE performs better than expected for a 486 machine without an external system RAM cache: It was in the second-fastest group of machines in both processor and memory speed and was in the top

FACT FILE
EDITORS' CHOICE



Dell System 425TE
Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; 800-937-1470, 512-338-4400.
List price (tested configuration): $8,717.
Memory and processor RAM cache: 8MB 80-ns. SIMMs.
Disk drives and controller: Micropolis 14-ms. 327MB ESDI, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.
Display: Dell 512K 1,024 by 768 adapter, Dell 13-inch monitor.
Software: DOS 4.01.

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PC Magazine, April 30, 1991

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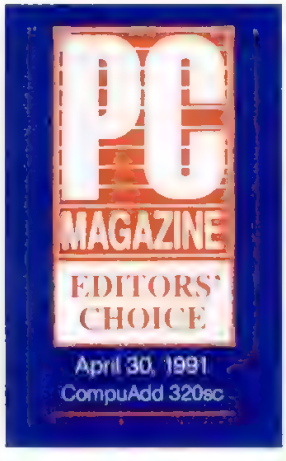

That "well-designed motherboard" has everything built on to it — "SIMM memory, floppy/hard disk controller, VGA video controller, and parallel and serial ports . . ." And the built-in Hi-Rez VGA controller gave the 320sc "a first-place finish on all video-related tests."

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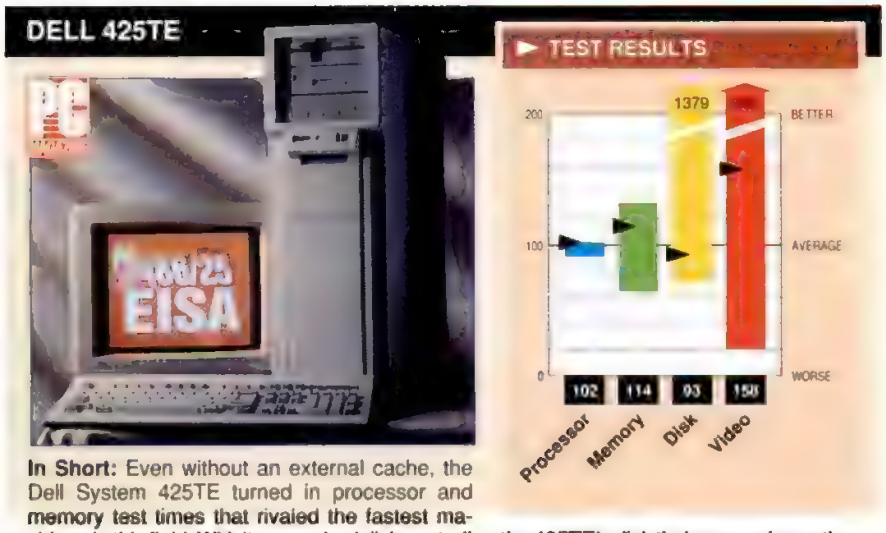
DELL 425TE



In Short: Even without an external cache, the Dell System 425TE turned in processor and memory test times that rivaled the fastest machines in this field. With its uncached disk controller, the 425TE's disk timing was slower than most of the other EISA machines. Compared with other noncaching systems, however, it performed quite well. This computer's strengths lie in its range of features. The company stands behind its product with excellent documentation and a strong support policy.

half on our disk and video benchmark tests. Although it may not be at the head of the performance pack, you're not likely to notice the difference for many applications.

Instead, the real value of this machine lies in its rugged design, its wealth of features, and the support of the company behind it.

ALUMINUM SIDING

At first glance, the Dell System 425TE's tower case looks unremarkable, with its feet in front and wheels in the back. But closer inspection reveals some important differences compared with your average clone case. Dell made the switch from steel to aluminum and shed 15 pounds in the process—nearly 25 percent of the base system weight.

There is a hatch on the top of the unit that slides forward to reveal the expansion card mounting brackets and a scoop-shaped cable cover that solves cable clutter gracefully. The motherboard includes one parallel, two serial, mouse, keyboard, and Super VGA video ports, and the connectors are all conveniently mounted at the top of the case near the expansion brackets.

Since the motherboard also includes both IDE hard disk and floppy disk drive connectors, you can have a fully configured system with all eight EISA slots available to you. (Our test model came with an ESDI hard disk, which required a separate controller in one of the expansion slots.) The system has earned an FCC Class B certification.

The motherboard is actually built in three pieces: the main board with the expansion slots and two extension boards that hold system memory and the various ports. Memory is provided by 4MB 80-nanosecond SIMMs; you can install from 4 to 64MB. There are 11 half-height bays, five of which are accessible through the front, giving you plenty of flexibility in configuration.

The System 425TE's other standout feature is Dell's service and support policies. The computer comes packaged with some of the best documentation I have seen—copiously illustrated, clearly written, and divided into a handful of separate, well-indexed booklets that make it extremely easy to find the information you need.

Dell's support goes well beyond printed materials, however. There is an 800 technical support number, an 800 number for fax technical support, a full-year warranty with on-site service by Xerox, and even a 30-day "no questions asked" money-back guarantee.

Dell is one of the pioneers in the direct marketing channel for computers and has succeeded in establishing a reputation for dependable and affordable systems. The 425TE can only enhance that reputation. Its extra features and solid design make it an appealing value in its field.

DTK COMPUTER INC.

DTK Feat-2502

by Patrick Honan

DTK takes the term "computer manufacturer" to heart, using its own motherboard, BIOS, floppy disk controller, and power supply in the Feat-2502. Though making many of its own parts helps ensure the overall reliability of the unit and enables DTK's ISA machine to boast a FCC Class B rating, it offers few other price or performance benefits.

PC Magazine's standard (and also tested) configuration, which includes 8MB RAM, 64K RAM cache, 201MB hard disk, 1.2MB floppy disk drive, Super VGA display, and DOS 4.01, costs $5,514. Our evaluation unit came equipped with a second floppy disk drive, which brought the retail price up to $5,599. DTK sells through dealers and resellers, so the actual price varies depending on how much of a discount the dealer offers. A 20 percent discount would drop the cost to a competitive $4,500—considerably less than that of other dealer-channel systems in this roundup.

In most respects, the Feat-2502 is comparable to other tower units. There's space for five half-height drive bays in the workstation. If you need more room, you can mount an additional chassis for a full-height drive near the lower right of the power supply. This chassis was not mounted in the tested unit, but DTK says

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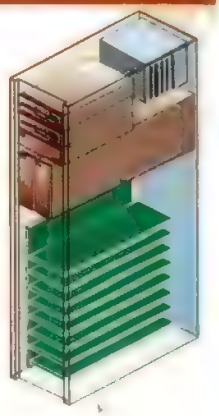


DTK Feat-2502
DTK Computer Inc., 15711 E. Valley Blvd., City of Industry, CA 91744; 818-333-7533.
List price (tested configuration): $5,599.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 64K cache.
Disk drives and controller: Conner 19-ms. 200MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: DTK 512K 1,024 by 768 adapter, Panasonic 14-inch monitor.
Software: DOS 4.01.

CIRCLE 417 ON READER SERVICE CARD

it can be provided free of charge to anyone who requests it. The five half-height bays are accessible from the front panel. There are six 16-bit slots, one 8-bit slot, and one 32-bit memory slot that can also accept 8-bit boards. Two slots were used in the tested unit: one for the Super VGA board, and one for the combination drive and I/O controller board.

System RAM is added to SIMM sockets on the motherboard or to the 32-bit memory board. You can have up to 12MB of the common 80-nanosecond, interleaved SIMMs used by the system on either the motherboard or memory board, but the system maximum is 16MB. The 64K RAM cache on the tested unit came with 25-nanosecond SRAM, but you can also get a 256K cache. In keeping with the homegrown design, integrated circuits and TTL circuitry built onto the motherboard control the cache.

PERFORMANCE PROBLEMS

DTK's special touches did not make the Feat-2502 excel in PC Magazine Labs' benchmark tests. In fact, with the exception of the 80486 Instruction Mix test, where it posted above average scores, the system performed rather poorly. The 19-millisecond Conner hard disk, with no onboard buffer or cache, had the second slowest time in the DOS File Access test. A notoriously slow Trident VGA chip set contributes to the system's poor performance in the PC Labs Direct to Screen video test.

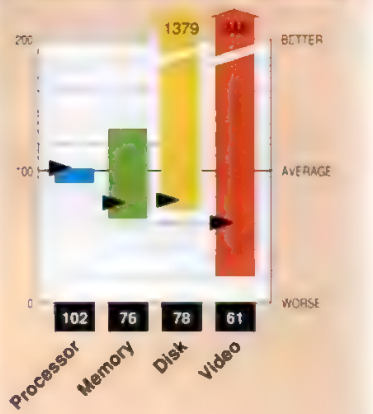
As is often the case when buying a system sold through retail channels, customers must go through the dealer for repairs. DTK offers free technical support, but you must pay for the phone call. In addition to the main office, five regional offices also provide technical support. The unit is covered by a one-year warranty.

> If you are interested in buying a unit from a vendor who dares to be innovative in a clone world, DTK's Feat-2502 is worthy of consideration.

If you are interested in buying a system from a vendor who dares to be an innovator in a clone world, DTK's Feat-2502 is worthy of consideration, especially if you want to use your computer at home. If price and performance are more important considerations, well, there are a lot of other fish in this sea.

DTK FEAT-2502

TEST RESULTS



In Short: The DTK Feat-2502 posted disappointing scores—though still within the norm. The slow Trident video chip set produced the second-slowest video timing. While the processor time was competitive, the Feat-2502's memory score fell to the bottom of the pack. (PC Labs spotted this tendency in other DTK-based systems.) With a Conner hard disk rated at 19 ms. and no buffer on DTK's drive controller, the system also turned in the second-slowest disk score.

DYNAMIC DECISIONS INC.

Dynex 486 ISA
Dynex 486E

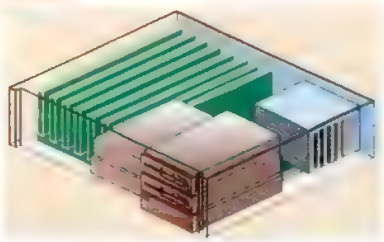
by John R. Quain

If you've ever watched a friend who's gained a little extra tonnage attempt to squeeze into clothes one size too small, you'll understand the predicament of these two systems from Dynamic Decisions. Both 25-MHz 80486 systems attempt to cram full-size 486 motherboards into AT-size cases, with unfortunate results. Neither system leads its bus-mates in terms of price, performance, or expandability.

In *PC Magazine*'s standard configuration, the $4,730 Dynex 486 ISA and $6,310 Dynex 486E share more than the same 6.25- by 21- by 16.5-inch (HWD) case. Both PCs come with 8MB of RAM installed on AMI motherboards that support the Weitek 4167 coprocessor. Each motherboard allows system and video BIOS shadowing via its AMI BIOS. Both machines have TEAC 5.25-inch and 3.5-inch floppy disk drives, an ATI Super VGA video adapter, and a Super VGA monitor.

Inside both machines, you'll also find the same 8-bit I/O card, which includes a 15-pin game port. With its connectors, the card takes up two slots, but it needn't. There are four connection punch-outs at the back of the case and enough slack in

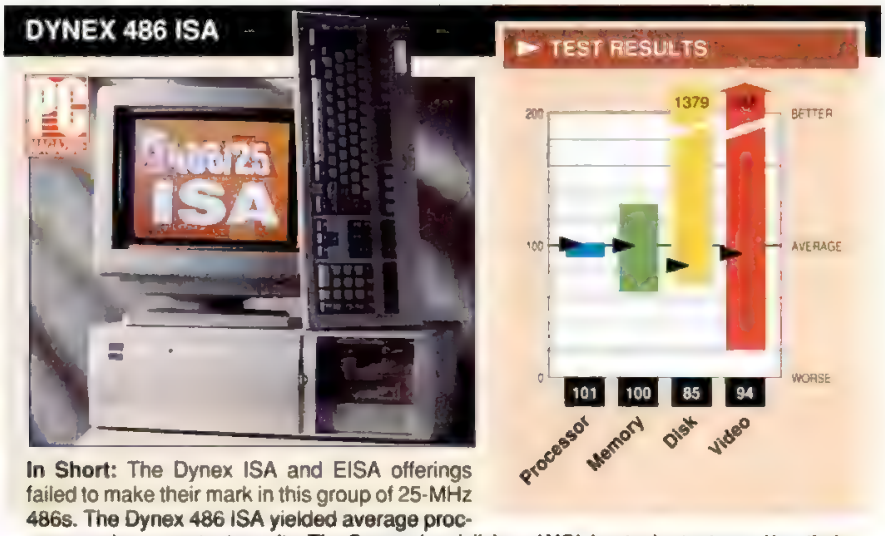
FACT FILE



Dynex 486 ISA
Dynamic Decisions Inc., 134 W. 26 St., New York, NY 10001; 800-869-9888, 212-242-0605.
List price (tested configuration): $4,730.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 128K cache.
Disk drives and controller: Conner 19-ms. 200MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: ATI 512K Super VGA adapter, Viewsonic 14-inch monitor.
Software: DOS 4.01.

CIRCLE 419 ON READER SERVICE CARD

DYNEX 486 ISA



In Short: The Dynex ISA and EISA offerings failed to make their mark in this group of 25-MHz 486s. The Dynex 486 ISA yielded average processor and memory test results. The Conner hard disk and NCL host adapter turned in a timing slightly below average, as did the 16-bit video subsystem. Beyond performance, the system reveals some ill planning: If, for example, you want to add memory, you must first remove the power supply. Overall, the unit has little to recommend it.

the cables to string the connections over and save the second slot.

UNIMPRESSIVE ISA

The Dynex 486 ISA system is founded on AMI's Voyager motherboard. It comes with 128K of 25-nanosecond RAM cache built in, and our standard configuration had four free 16-bit slots. The page-mode RAM arrangement of 70-ns. SIMMs should make upgrades easy. However, you'll be forced to remove the power supply if you want to add more memory and replace the 1MB modules with 4MB packages.

PC Magazine Labs' benchmark tests on the Dynex ISA unit yielded average processor and memory results. The 19-millisecond 200MB Conner IDE hard disk and NCL host adapter turned in slightly below-average times, as did the 16-bit video subsystem, which included a 14-inch color Viewsonic monitor.

LIKEWISE EISA

Dynamic Decisions' 25-MHz 486 EISA offering didn't fare much better.

The AMI Enterprise motherboard's poor fit in the Dynex 486E case was even more severe than that of the ISA configuration. This was amply demonstrated by the fact that the 8MB of RAM in this machine was actually pressed up against the 230-watt Senstron power supply. Considering the unavoidable heat buildup, this position is far from advantageous and is bound to cause problems for the heat-sensitive memory modules. The Dynex 486E's expandable 64K of 25-ns. external RAM cache, situated on a small plug-in board, failed to deliver a perceptible performance boost over other EISA or ISA machines in this group, yielding only average processor scores.

The Dynex 486 EISA uses a 340MB Micropolis hard disk controlled by a DPT SCSI host adapter. Its disk file access tests delivered somewhat better results than those of machines in the ISA pack—in fact, the best among systems without caching controllers—though not necessarily enough to recommend the larger investment here. Aside from the EISA 32-bit bus design's ability to yield higher burst-transfer rates, our tests didn't reveal a proportional performance increase that might draw buyers to this EISA over the Dynex ISA. Moreover, compared with other EISA machines, the Dynex 486E's performance and features were average.

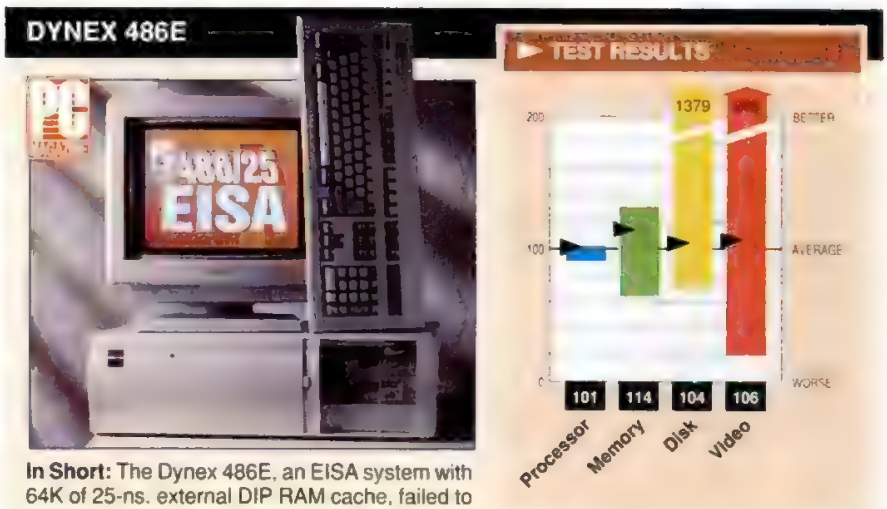
Further undercutting the undistinguished performance and design were some other minor complaints. The documentation for both systems is underwhelming: It includes only the controller card, video adapter, and AMI manuals.

PROBLEM CASE

The problematic case that Dynamic Decisions uses for both machines has a curved facade with an awkward sliding door that conceals the drive bays. It's a space-eater and not as sturdy as tower-case floor models. If you still want the solid AMI motherboard, the chassis constraints can be solved by chipping in an additional $90 for a roomier tower box from Dynamic Decisions. However, there are other vendors in this roundup that offer better performance than Dynex's middling scores—and for less money. These Dynex machines fail to stand out in our review group because of their poor design and mediocre performance.

Dynex provides a one-year parts-and-labor warranty and offers on-site service through TRW (except in New York City,

DYNEX 486E



In Short: The Dynex 486E, an EISA system with 64K of 25-ns. external DIP RAM cache, failed to deliver a perceptible performance boost over EISA or ISA machines in this group, with a processor test result about average. The disk test delivered a score only marginally superior to machines in the ISA pack, though this was the best of all the systems with uncached controllers. Like its ISA counterpart, the Dynex 486E has a desktop case that cries out for more space for the AMI motherboard inside.

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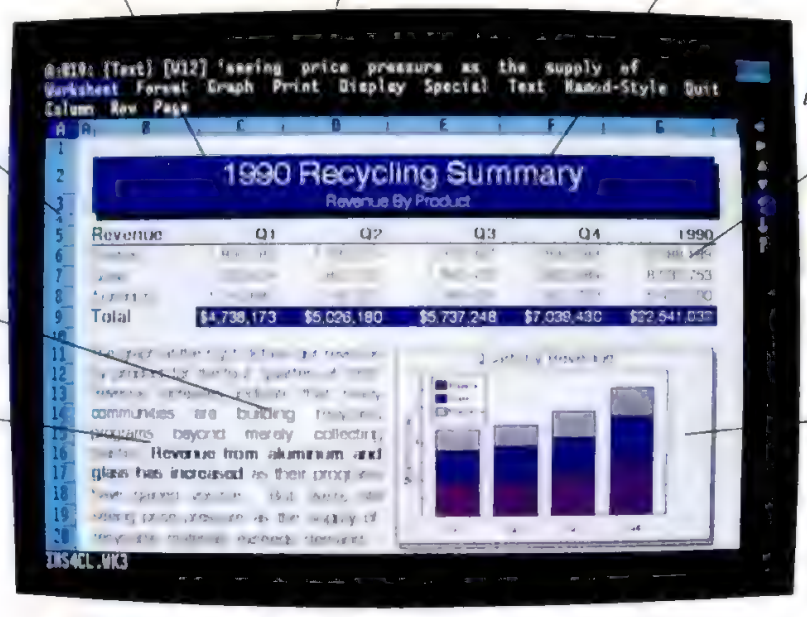

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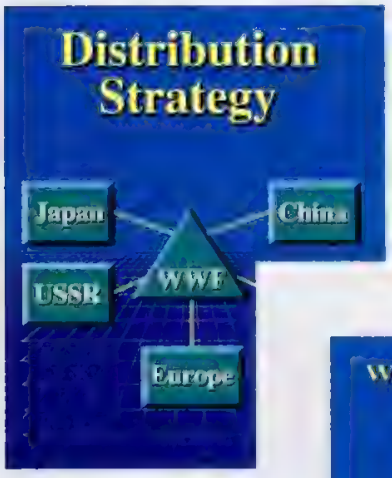

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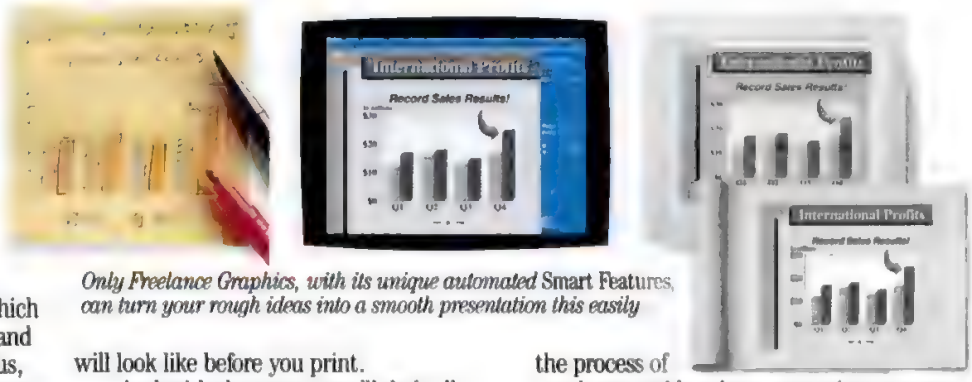

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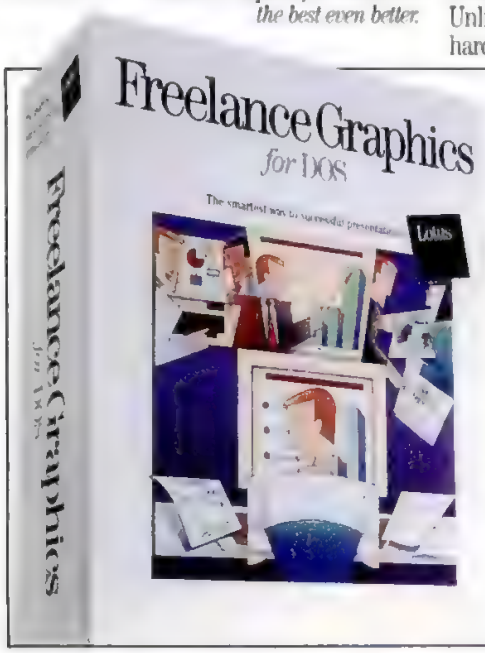

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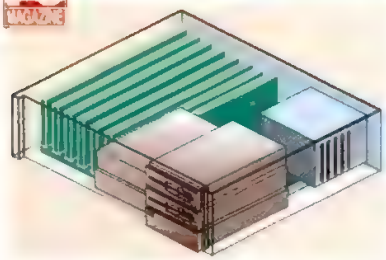
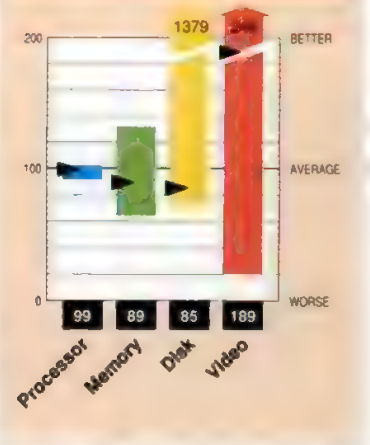


Dynex 486E
Dynamic Decisions Inc., 134 W. 26 St., New York, NY 10001; 800-869-9888, 212-242-0605.
List price (tested configuration): $6,310.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 64K cache.
Disk drives and controller: Micropolis 14-ms. 340MB SCSI, DPT controller, 1.2MB and 1.44MB floppy disk drives.
Display: ATI 512K Super VGA adapter, Viewsonic 14-inch monitor.
Software: DOS 4.01.

CIRCLE 418 ON READER SERVICE CARD

DYNA 486 25 CACHE

TEST RESULTS



In Short: The Dyna Work Master 486 25 Cache turned in uneven performance, though somewhat better than average. It handed in the best video test score but lower-than-average performance even among uncached drives. Our evaluation unit came in a mini-tower case, with somewhat limited room for expansion, but you can order larger cases. The one-year on-site warranty is a plus, and every important feature in this nicely balanced package weighs in at slightly above the norm.

which the company covers itself). However, because Dynamic Decisions generally sells its machines through VARs, you're not likely to see any Dynex systems around the corner at Joe's Computer Warehouse. But then again, there's no particular reason for you to go looking for them, either.

DYNA MICRO INC.

Dyna Work Master 486 25 Cache Dyna Work Master 486 25 Cache EISA

by M. David Stone

Although Dyna Micro sells its systems only through dealers and direct to corporations, the company says it builds all systems to order. As such, you can think of the Dyna Work Master 486 25 Cache and the Work Master 486 25 Cache EISA as variations on a theme. The difference between them is the motherboard—with your choice of ISA or EISA slots. Either way, each system offers a set of features that is consistently above average.

The *PC Magazine* standard configuration for the Dyna Micro systems costs $6,689 for the EISA version or $4,839 for the ISA. In both cases, the price includes 8MB RAM, 256K RAM cache, 1.2MB or 1.44MB floppy disk drives, 337MB half-height hard disk, an 800-by-600 Super VGA video subsystem (with 1,024- by 768-pixel interlaced capability), and DOS 4.01. As tested, the ISA system matched the standard configuration exactly, except for a second floppy disk drive (which added $60 to the price). The EISA machine differed from the standard in adding the second floppy disk drive ($60) and substituting a full-height hard disk ($50).

According to Dyna Micro, the only reason for the hard disk substitution was a lack of sufficient half-height hard disks in stock. However, the difference may have some impact on system performance. The company's usual 300MB-plus ESDI hard disk offers a 15-millisecond average access time. The substitute in the EISA unit was marginally faster, at 14.5 ms.

DISK PERFORMANCE

Indeed, the EISA unit turned in notably better disk performance than the ISA unit. But the difference in raw disk performance was certainly outweighed by the effects of the controllers. The ISA unit included an UltraStor 12F with a 32K buffer, but we required ISA systems to have noncached controllers. The EISA unit included the UltraStor Ultra-22C, with 512K of intelligent cache. The difference in controllers yields slightly lower-than-average performance for the ISA drive compared with the somewhat sluggish performance of other EISA systems with caching controllers.

As tested, both systems came with identical, 16-inch-high mini-tower cases. The five drive bays in each include a stack of three half-height bays and a stack of two 3.5-inch bays. Equally important, all five bays are accessible.

As you might expect from the small case, both units were somewhat crowded inside. In particular, more than a third of the motherboard in each system is hidden under the drive bays. On the EISA system,

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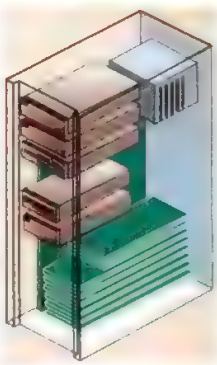

Dyna Work Master 486 25 Cache
Dyna Micro Inc., 30 W. Montague Expwy., San Jose, CA 95134; 800-336-3962, 408-943-0100.
List price (tested configuration): $4,899.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Seagate 15-ms. 337MB ESDI, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, ADI 14-inch monitor.
Software: DOS 4.01.

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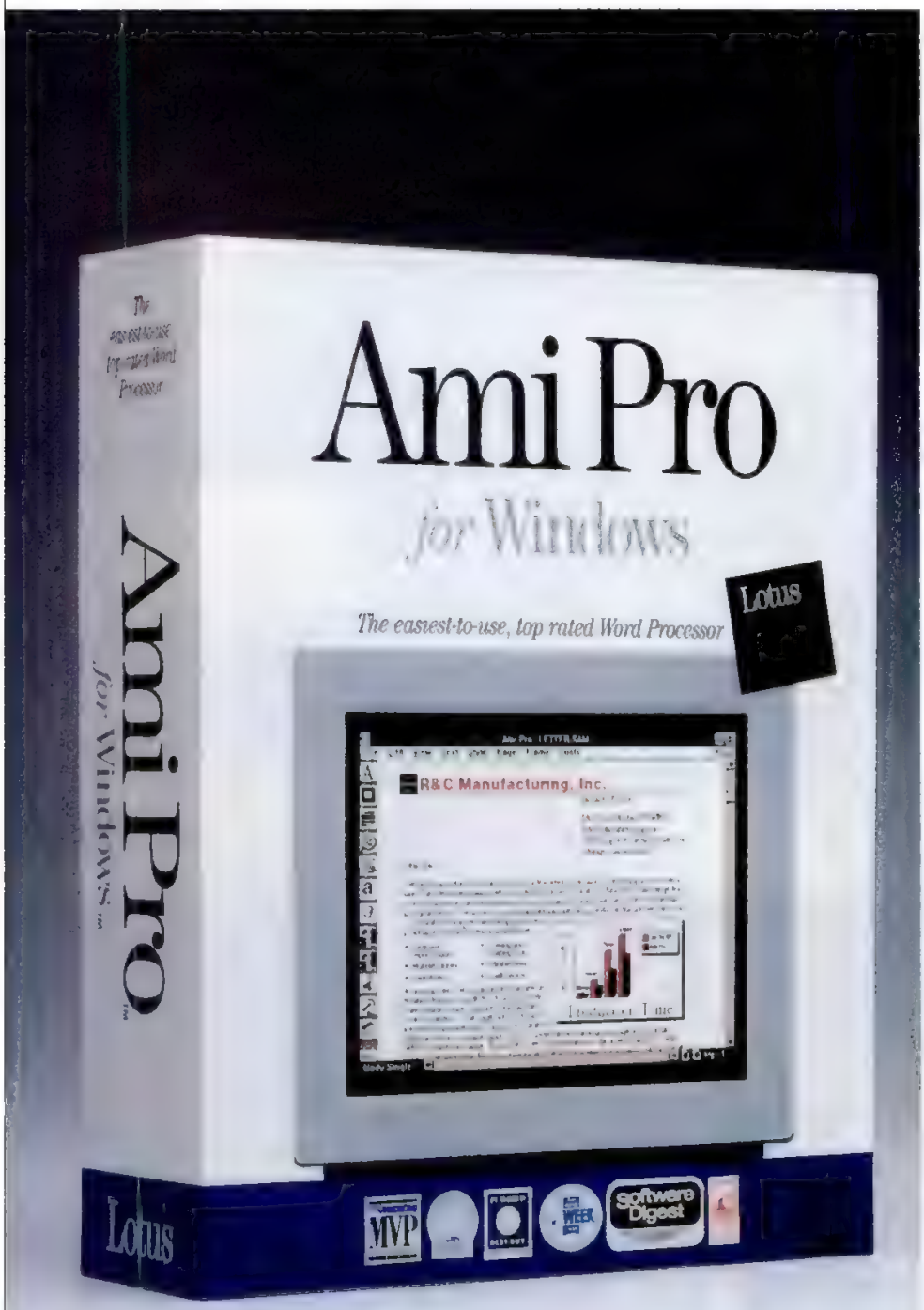

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CIRCLE 143 ON READER SERVICE CARD

the hidden part includes the Weitek coprocessor socket, so adding a coprocessor becomes a nontrivial task. Also, the SIMM sockets in both units are tucked between the slots and a crossbar on one side and the power supply on the other, making it difficult to add or remove SIMMs.

STATE YOUR CASE

For those who prefer a different case, Dyna Micro offers six choices: slim, small-footprint desktop, standard desktop, mini-tower, tower, and super tower. The number of drive bays varies from a meager three 3.5-inch bays in the slim case to a more-than-ample ten half-height bays on the super tower. With this range of choices, you can have anything from a small-footprint executive system to a behemoth server with lots of drive bays.

Both the EISA and ISA systems use AIR motherboards. Not surprisingly, the motherboards offer a similar list of components, including a 486/25 processor, a coprocessor socket for a Weitek 4167, 256K cache using relatively slow 30-nanosecond SRAM, discrete logic for cache control, and a combination of discrete logic and Chips and Technology chips for the chip set. One minor difference we found was an AMI BIOS in the ISA system as opposed to a Phoenix BIOS in the EISA system. However, since both are reliable choices, the difference isn't particularly meaningful.

All system RAM in each unit goes into the 16 SIMM sockets, using 1MB SIMMs for the ISA system and either 1MB or 4MB SIMMs for the EISA. As you would expect, the ISA system is limited to a maximum of 16MB RAM compared with 64MB for the EISA system. Each review unit had eight 1MB SIMMs installed, using 80-ns. RAM.

Both motherboards offered eight expansion slots, with all 16-bit slots in the ISA system and all 32-bit slots in the EISA. Each of our review units had five slots free, though the filled slots contained a different combination of boards in each unit.

The three ISA system slots were filled with a video card, a serial/parallel card, and the disk controller. The EISA system saves a slot by including the serial and parallel ports on the motherboard. However, as with other EISA systems that use the Ultra-22C caching bus-master controller, the Dyna Micro unit needed an additional slot for a floppy disk drive controller. In the ISA system this isn't much of an issue, since it still leaves five slots free for expansion. The EISA motherboard also has provision for a mouse connector, an $85 option.

ISA VIDEO SPEED

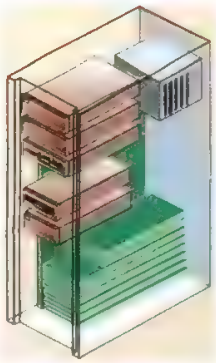
Both review units came with the Orchid ProDesigner II video card. However, the card yielded significantly different performance in the two systems, with merely average results in the EISA system compared with excellent performance in the ISA. In fact, except for disk performance, which benefits mightily from the EISA system's caching controller, the ISA system is the better performer of the two.

These results suggest that you can get a better value with the ISA system and an upgrade to a caching controller. Or, you can get Dyna Micro's identically equipped 486/33 ISA system for $5,999—$750 less than the 486/25 EISA but yielding a processor speed gain of as much as 25 percent. Also note that an identically equipped 386/33 ISA system is $3,599—$1,300 less than the 486/25 ISA. If you are committed to EISA, you should consider the Dyna Micro's 486/33 EISA system, selling for just $450 more, at $7,199.

All Dyna Micro units come with a one year on-site warranty for parts and labor. On-site service is available through Integrated Automation, which claims a 24-hour response time anywhere in the U.S. or Canada, with a repaired or replacement system supplied within 48 hours. Almost as important, Dyna Micro offers unlimited, toll-free technical support, available from 8 A.M. to 5 P.M. P.S.T., Monday through Friday.

Interestingly, neither of the Dyna Micro systems has any one feature that stands out significantly from the crowd. Yet each key area of user concern—price, performance, support policy, and flexibility in system design—appears notably better than average. And that combination adds up to an interesting whole.

FACT FILE

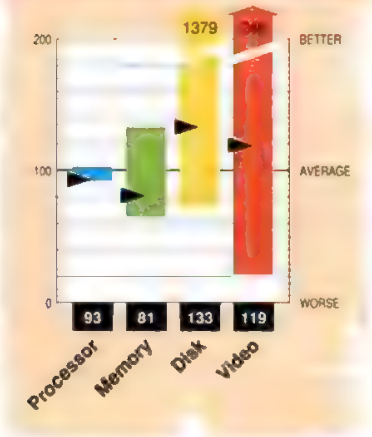


Dyna Work Master 486 25 Cache EISA
Dyna Micro Inc., 30 W. Montague Expwy., San Jose, CA 95134; 800-336-3962, 408-943-0100.
List price (tested configuration): $6,749.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Imprimis 14.5-ms. 329MB ESDI, UltraStor controller, 512K cache, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, ADI 14-inch monitor.
Software: DOS 4.01.

CIRCLE 421 ON READER SERVICE CARD

DYNA 486 25 CACHE EISA

TEST RESULTS



In Short: The Dyna Work Master 486 25 Cache EISA showed average scores, but individual scores were slower than you might expect. The Orchid ProDesigner II video card managed only a middling result. Similarly, the 14.5-ms. hard disk and caching controller were slowest among systems with the same controller. Processor and memory timings were weak, too. Strong points include a year of on-site service and a relatively low price for an EISA PC, though neither factor should sway your buying decision.

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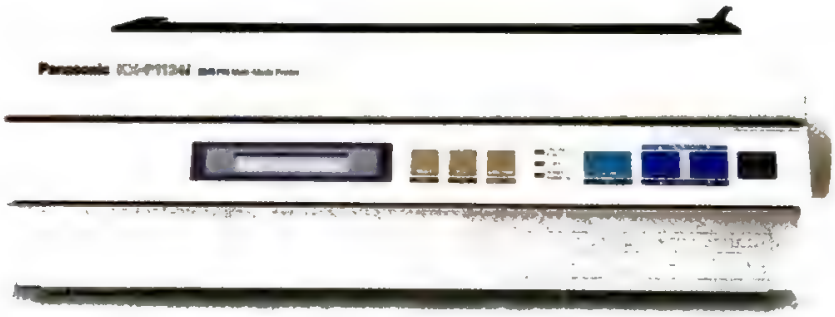

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CIRCLE 122 ON READER SERVICE CARD

EPS TECHNOLOGIES INC.

EPS 486/25 Tower

by Pat Honan

With its generic name and typical tower design, the EPS 486/25 Tower gets easily lost in the crowd of 486 computers. But behind its mundane exterior are strong expansion options, an attractive price, good service and support, and solid performance. Combined, they make the 486/25 Tower stand a cut above the run-of-the-mill 486 ISA system.

The $4,195 price for our standard configuration includes 8MB of RAM, a 128K RAM cache, one floppy disk drive, a Maxtor 15-millisecond 200MB hard disk, and a Super VGA display. A second floppy disk drive, game port, *Windows* 3.0, and a Logitech mouse are also included in the price. EPS sells direct, so there are no discounts on this price. While it's not the least expensive 486 system you'll find, the price is competitive. Even so, you may want to pass by the reviewed unit for EPS's 33-MHz 486 tower unit, which costs just $400 more for the same configuration: a 10 percent greater price for about 25 percent greater processor performance.

Perched on its floor stand, the 486/25 Tower measures 26 by 7.5 by 18 inches (HWD). The power, reset and turbo buttons and keyboard lock are all within easy reach along the front panel.

Internally, the motherboard is of EPS's own design. It features an OPTi chip set and AMI BIOS that supports shadowing of the system and video BIOS through the CMOS setup program. EPS offers one RAM cache size: 128K of 25-nanosecond static RAM. You can add a maximum of 16MB of system RAM, all of which can be installed on the motherboard using 1MB SIMMs.

Those looking for a file server will not have to worry about filling the 486/25 Tower's six half-height drive bays and two 3.5-inch bays too quickly. All but two of the half-height bays are accessible from the front of the computer, leaving plenty of room to add devices that use removable media such as tape drives, CD-ROM players, or erasable optical drives. There is one hitch: The bays not accessible from the front are parallel to the control switches on the front panel and must be recessed slightly to clear the wires leading to and from these switches. This makes for a tight fit against the power supply at the rear of the case, and some deeper drives may not fit.

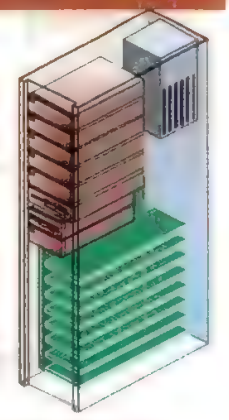
The system comes with six 16-bit slots and two 8-bit slots. Video, I/O ports, and the integrated floppy/hard disk controller are all on boards, leaving four 16-bit and one 8-bit slots open for additions like internal modems or additional device controllers.

The 486/25's speed is average, overall. It did best on the Direct to Screen video test, tying for third place thanks to its Orchid ProDesigner II video card. Its processor, memory, and disk test scores were also solid across the board.

EPS covers the 486/25 Tower with a fairly standard one-year warranty on parts and labor, but also kicks in a 60-day money-back guarantee and one year of free on-site service provided by TRW. (The Orchid board included with the tested configuration comes with a four-year warranty.) A toll-free technical support line is available every day of the week except Sunday. The system lacked FCC Class B certification at the time of the review.

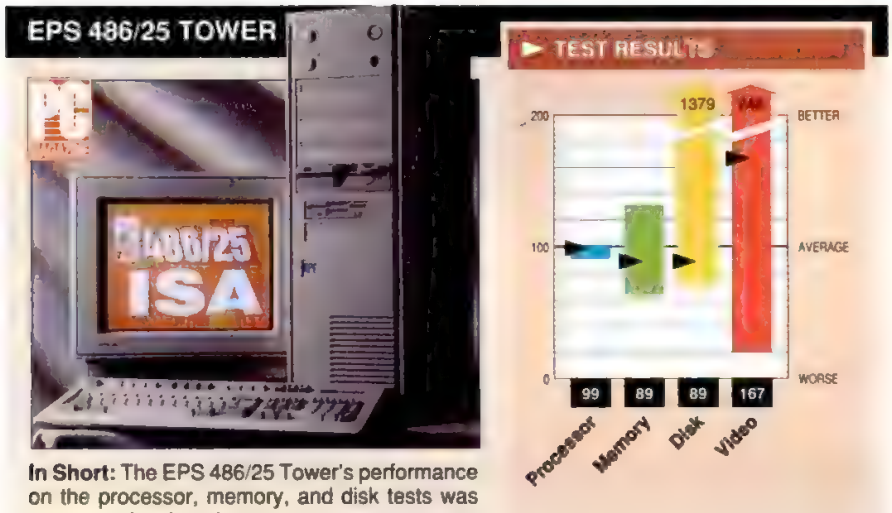
If price or speed requirements dominate your purchase decision, there are systems that beat the 486/25 Tower, including it's own 33-MHz sibling. But if you're looking for a 25-MHz system with plenty of room for future expansion and reliable performance at a fair price, EPS's 486/25 ISA deserves a strong look.

FACT FILE



EPS 486/25 Tower
EPS Technologies Inc., 10069 Dakota Ave., Jefferson, SD 57038; 800-447-0921, 605-966-5586.
List price (tested configuration): $4,195.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 15-ms. 200MB IDE, 32K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Optiquest 15-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

CIRCLE 422 ON READER SERVICE CARD



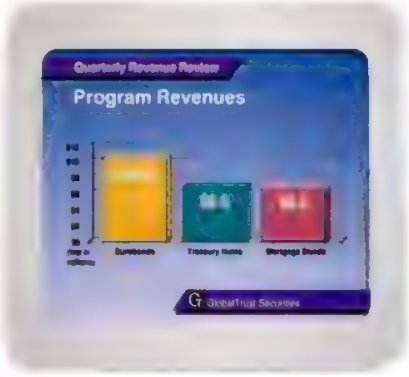
In Short: The EPS 486/25 Tower's performance on the processor, memory, and disk tests was average, due largely to common components such as the 80-ns. hard disk with no disk cache. Performance on the video test was better, but numerous systems bunched tightly together on this test. The expansion options—six half-height drive bays, two 3.5-inch drive bays, and five open expansion slots—make this machine a solid choice as a file server.

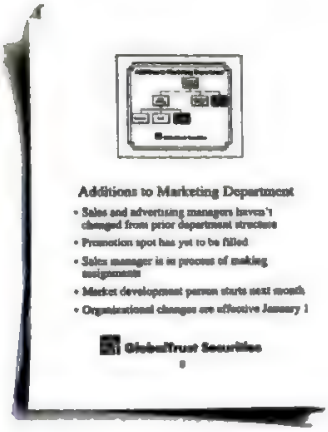
HEWLETT-PACKARD CO.

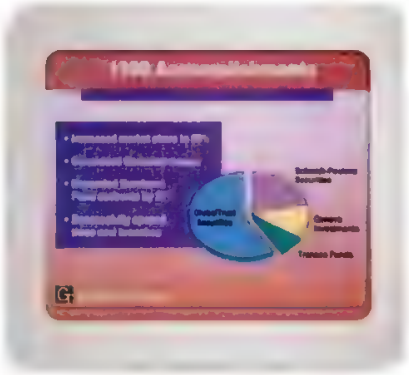
HP Vectra 486

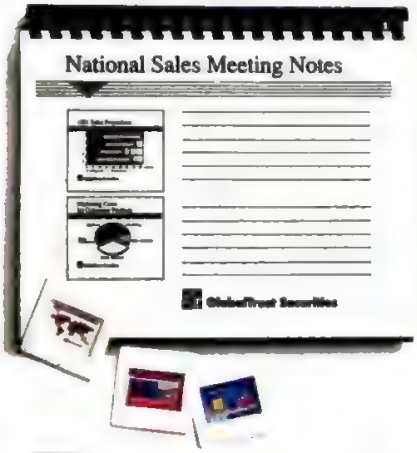
by Edward Mendelson

If you've ever used a Hewlett-Packard LaserJet, you know what to expect from an HP computer: sturdy and luxurious construction combined with solid and reliable performance. The EISA-based 25-MHz HP Vectra 486 doesn't advance into new ground the way some of HP's print-









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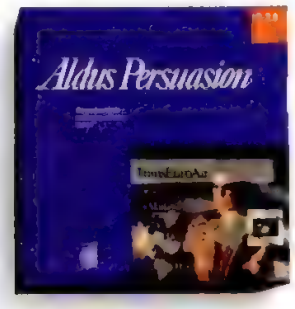

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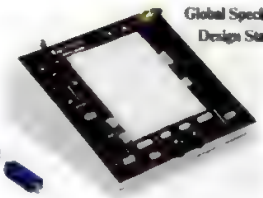
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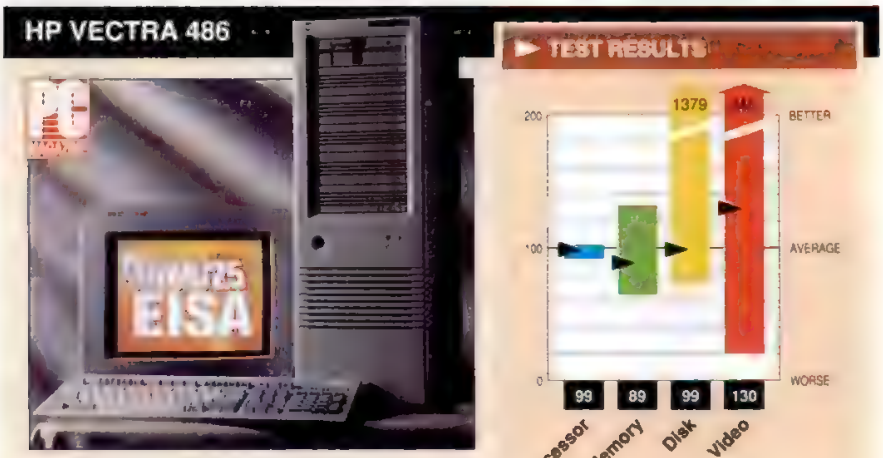
CIRCLE 179 ON READER SERVICE CARD

HP VECTRA 486



In Short: The HP Vectra 486 turned in average performance on all benchmark tests, even without processor or disk caches. This machine stands out not as a top performer but as a solidly, stylishly designed EISA machine. Built-in I/O ports and the floppy disk controller save expansion slots, and six half-height drive bays (plus six power-supply connectors) should fill the storage and backup needs to function as a network server. The construction quality makes this computer a serious contender.

ers do, but it does offer an almost ideal combination of sturdiness and expandability. If what you're looking for is a network server or high-capacity workstation that's likely to stand up to any treatment or accommodate almost any reasonable expansion needs—and you're willing to pay a premium price for premium quality—HP markets one of the best available choices.

The system tested by PC Magazine Labs, which included 8MB of RAM (on two 4MB SIMMs), a 330MB ESDI hard disk, a 1.2MB floppy disk drive, and HP's Super VGA video subsystem, will cost you $13,395.

HP doesn't use an external processor cache in its 25-MHz systems. The Vectra's performance in all categories of testing was average among 25-MHz systems, but you're unlikely to feel that the slight additional speed you can get from other systems is enough to justify giving up the reliability you can expect from HP.

NEW SYSTEM, SAME PRICE, MORE MEMORY

By the time you read this, HP will have introduced the Vectra 486/25T, an upgraded version of the Vectra 486 that will sell at the same price but will provide 2MB more RAM than the original model and will come with a SCSI-2 hard disk system that HP recently introduced in the Vectra 486/33T. The ESDI drives used in the original Vectra 486 will still be available as an option at the same price. The one-year warranty on the original Vectra 486 lets you return the machine for service to the dealer or manufacturer; the improved 486/25T will come with one year of on-site service as well. You also get HP's toll-free telephone support (with the numbers listed in the manual), plus advice and software upgrades on the company's CompuServe forum.

A similarly configured 486/33T with 128K cache will cost you exactly $2,000 more than the corresponding 486/25T. The price difference is substantial enough to make either system a dauntingly expensive but reliable choice in its price class. And unless you intend to use this system for heavy-duty CAD or similar applications, you may not find that the average 25-percent speed increase justifies the additional price. HP doesn't offer a 33-MHz 386.

Any model of the Vectra 486 will give you a PS/2-style mouse port, a serial port, and two parallel ports without wasting any expansion slots, and the floppy disk controller is included on the motherboard. The result is that you give up two of the eight 32-bit EISA expansion slots to the hard disk controller and video card and have six slots free.

The tower case can hold six half-height storage devices, all accessible from the front panel. In PC Labs' test machine, which had a full-height 330MB drive and half-height 1.2MB floppy disk drive installed, three half-height bays remained empty.

DOUBLE COVERAGE

The HP Vectra 486's handsome steel tower case has a keyboard lock and case lock but no reset switch. When you lift off the outer cover, you find a second heavy metal cover shielding the motherboard and drives; the connectors that hold this cover can be opened with a small coin or screwdriver. HP uses a backplane design that mounts processor and RAM on separate daughtercards. The memory card can hold up to 64MB of 80-nanosecond 4MB SIMMS.

A metal cage placed over the 486 chip that reduces RF emissions helped this machine attain its FCC Class B rating. Two more daughtercards hold the I/O, mouse, and keyboard ports. Everything inside the unit is easily accessible and beautifully finished, although there were a couple of tracer wires on the motherboard indicating last-minute fixes.

Even in its improved 25T model, the Vectra 486 doesn't offer any special performance advantages—even the new SCSI-2 system retains the 8-bit data bus from earlier SCSI models—but it offers highly tangible advantages in construction and service. HP positions this computer for high-end CAD work, as a server, or as a multiuser machine. If you don't mind paying the price for HP's quality, it's hard to see how you could go wrong buying the Vectra 486.

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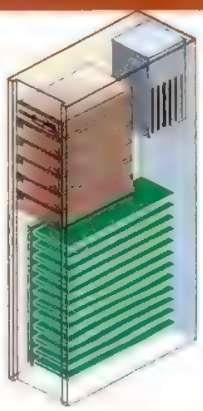


HP Vectra 486
Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900.
List price (tested configuration): $13,395.
Memory and processor RAM cache: 8MB 80-ns. SIMMs.
Disk drives and controller: Hewlett-Packard 16-ms. 330MB ESDI; Adaptec controller, 64K cache; 1.2MB floppy disk drive.
Display: Headland 256K VGA adapter, Hewlett-Packard 14-inch monitor.
Software: DOS 4.01.

CIRCLE 423 ON READER SERVICE CARD

HIQUALITY SYSTEMS INC.

HiQ 425i

by Bruce Brown

If price is your primary driving factor in computer purchasing, look closely at the HiQuality Systems HiQ 425i. The system comes with a well-known assortment of parts inside. But if you require on-site service as an option, you'll have to look elsewhere.

The HiQ 425i costs a measly $3,699 in our test configuration, which coincided with the standard configuration for this review. The test machine included 8MB of RAM, an external 64K RAM cache, a 201MB 16-millisecond IDE hard disk, both a 1.2MB and a 1.44MB floppy disk drive (these come standard), a 1,024- by 768-pixel video board with 1MB RAM, and a 14-inch color Super VGA monitor.

The Free Technology motherboard uses an Intel chip set and AMI ROM BIOS. The system's maximum 16MB RAM will fit on the motherboard using 80-nanosecond 1MB SIMMs. The external 64K processor RAM cache with its 25-ns. SRAM SIPs should be ample for most applications, although the motherboard can hold up to 256K.

There are eight 16-bit ISA expansion slots on the Free Technology motherboard, all capable of holding full-length interface cards. In the test machine, I/O, video, and drive interface cards each took one slot, leaving five slots free. Room for expansion is one drive better in the HiQ 425i than in most desktop systems. The standard size tower case has space for six half-height drives, four of which are accessible.

Just to show that high cost doesn't always add up to high performance, the HiQ 425i tied for fastest on our processor tests and came in second on the memory test. The Orchid ProDesigner II performed adequately on our video tests, though not as well as the same card did in some other systems. And the Maxtor hard disk's performance compared favorably with that of its ISA counterparts.

The biggest news about this system is not performance, however; it's low price. When you compare the 425i to other machines sold by the same vendor you find roughly a $600 delta between performance categories. A similarly equipped HiQ 386/33 costs $3,099—$600 less, but without the math coprocessor that is built in to the 80486. A 33-MHz ISA 486 from HiQ costs $4,289—$580 more, but with a 25 percent faster processor for roughly 16 percent more money.

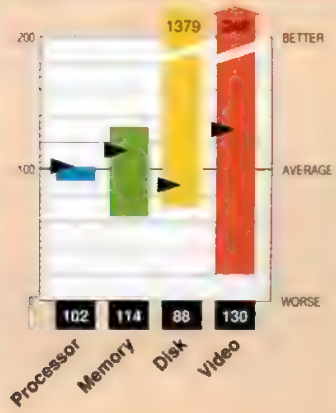
HiQuality Systems sells computers via mail and telephone order. All systems come with a one-year parts, two-year labor warranty and a 30-day money-back guarantee. There is a toll-free technical support line with parts shipping for identified defective components. The telephone service operates 9:00 A.M. to 6:00 P.M. P.S.T., Monday through Friday, and from 11:00 to 4:00 P.S.T. on Saturday. Unfortunately, HiQ doesn't provide standard backup or primary on-site service; if you can't identify a defective component on a troubled machine or if the whole system is down, you have to send the computer to HiQ's California facility. The vendor pays for shipping one way.

While HiQ's incidence of machines sent back for service may be very low, mail-order buyers have come to expect and demand on-site service. HiQ's lack of such an option should override the attraction of its low prices for all but those users who have access to their own maintenance and system repair facilities. ■

HiQ's lack of on-site service should override the attraction of its low prices for all but those users who have access to their own repair facilities.

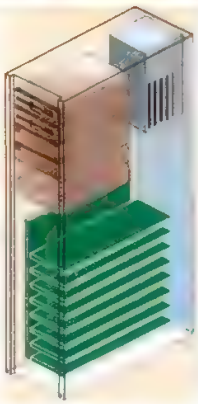
HIQ 425I

TEST RESULTS



In Short: The HiQ 425i is an average performer. The Orchid ProDesigner II video board helped the system achieve a slightly faster-than-average video timing, but it was not as fast as other systems using this board, and the IDE hard disk produced a slightly below-average time on the disk test. This ISA system comes in a tower case with six half-height drive bays. If only it came with an on-site service option, the system would have been one of the best buys we reviewed.

FACT FILE



HiQ 425i
HiQuality Systems Inc., 740 N. Mary Ave., Sunnyvale, CA 94086; 800-827-5836, 408-245-5836.
List price (tested configuration): $3,699.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 64K cache.
Disk drives and controller: Maxtor 16-ms. 200MB IDE, IDE controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Matsushita 14-inch monitor.
Software: DOS 3.3.

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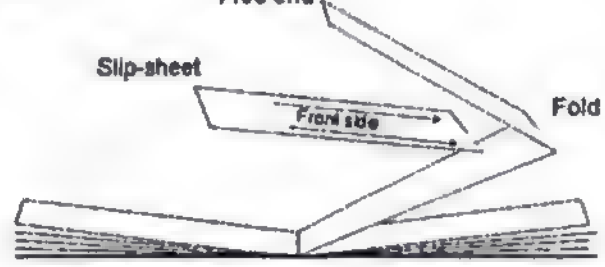
4. Close the page and slip-sheet



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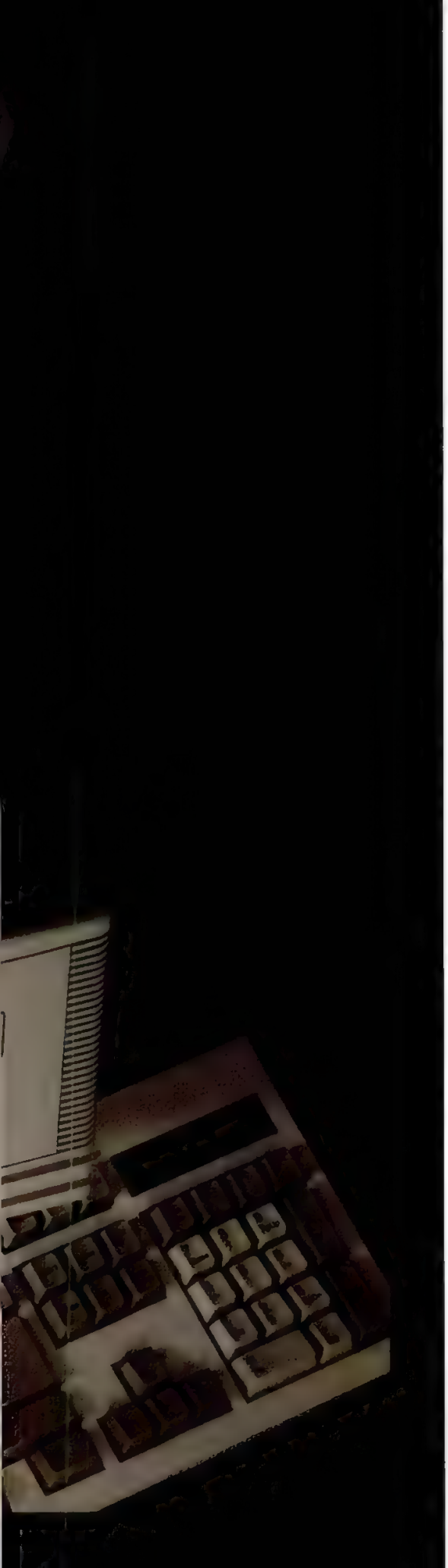
GbsSlipBack-0018

Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side



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IBM PS/2 Model 55SX	4.46	8.46
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Your ZEOS 386SX is designed and manufactured right in our own laboratories. We have used only the *very best* components available. From the power supply right thru to the video, every component is absolute top quality.

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10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but *seven* times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS...is the best value we've come across...its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5

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ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

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Reason #7

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ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9

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ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, Discover, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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A married person may apply for individual credit. I am applying for (please check appropriate box):

☐ **JOINT CREDIT** with another person. Complete entire application.

☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.

☐ **INDIVIDUAL CREDIT.** Do not complete Section C.**

**If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

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☐ married ☐ unmarried ☐ legally separated

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Soc. Sec. No. _____ Date of Birth ____/____/____

Address _____ Apt. _____

City _____ State _____ Zip _____

Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____

Previous Address _____

City _____ State _____ Zip _____

Employer _____ Since? (Mo./Yr.) _____

Monthly Gross Salary $ _____ Daytime Bus. Phone (_____) _____

Previous Employer _____ From - To _____

Occupation _____

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying this obligation.

Additional Monthly Income $ _____ Source: _____

Name & Address of Nearest Relative Not Living With You _____

_____ Relationship _____

B. CREDIT INFORMATION

PLEASE TELL US IF YOU HAVE: Checking Account ☐ Yes ☐ No
Savings Account ☐ Yes ☐ No

	Y/N	How Many?		Y/N	How Many?
Bank Loan	___	_____	Dept. Store Charge Card	___	_____
VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

Joint Applicant's Name _____

Soc. Sec. No. _____ Date of Birth ____/____/____

Address _____ Apt. _____

City _____ State _____ Zip _____

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Joint Applicant's Employer _____ Since? (Mo./Yr.) _____

Bus. Phone (_____) _____ Monthly Gross Salary $ _____

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HWP-256	with 256KB	$325
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From 256KB to 16MB buffer

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All parallel ports; user configurable as either three inputs to two outputs, or four inputs to one output, buffered auto-switch

Rapid Data Transfer – 100,000 cps:
The HWP uses Direct Memory Access (DMA) for data transfers into the buffer, making the HWP hardware capable of receiving parallel data at the high rate of 100,000 characters per second.

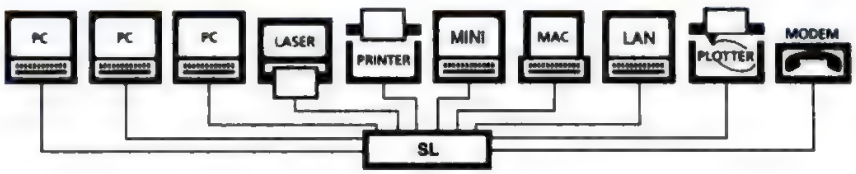
Pop-up Menu or Front Panel Buttons:
Use either the pop-up menu or the front panel switches to select printers, select the next available printer, send multiple copies, clear data, and other functions.

AS-41 — *5 Ports* — *$200*

Smart Switch – No Pop-up or Buffer:
Four parallel inputs to one parallel output, electronic automatic switch with no buffer

SPPS — *(not shown)* — *$100*

Interface Converter – No Buffer
Combination serial-to-parallel, or parallel-to-serial interface converter in a single unit; low-power CMOS design derives power from serial connection, no power supply needed; supports 9,600 to 115,200 bps, DIP switch configurable



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SL – four parallel and six serial ports
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Both include 15 ft. serial null-modem cable

User Upgradable Memory:
From 256KB to 4MB buffer

Any Combination of Printers or PCs:
All ten SL or SLP ports can be software configured as either input or output.

Automatically Routes and Buffers Data:
Automatic switching and queuing of jobs; automatically converts data from parallel-to-serial or serial-to-parallel

115,200 bps PC-to-PC File Transfers:
Transfer files serially between PCs up to 115,200 bps; buffer serial data to the SL several times faster than normal 9,600 bps

Pop-up Menu via Hotkeys or Mouse:
Keyboard selection of printers and many other control functions; pop-up is for convenience, but is not required

Simple Installation:
Plug in your cables; if desired, run the installation software for the pop-up menu

CIRCLE 328 ON READER SERVICE CARD

Magneto-Optical Drives:

Fulfilling The Promise of Rewritable Optical?

They're faster than floppies but slower than hard disks. They're more expensive than hard disks but cheaper than 8-mm. tape. They're reliable, removable, and rewritable. But are magneto-optical drives the ultimate storage solution for you?

by M. David Stone

Since 1972, when the laser videodisk first displayed the powers of write-once optical storage, the world has yearned for a rewritable optical disk. Today's consumer electronics market has yet to deliver a rewritable CD to home audiophiles—even though manufacturers have already demonstrated the technology. But the PC industry is ripe with choices for the end user who wants a rewritable optical storage device.

The most viable rewritable (also called erasable) optical device available today is the magneto-optical (MO) disk drive, which borrows from both magnetic and optical technologies. Introduced in 1988, the magneto-optical drive provides the removability of floppies and the Bernoulli Box, the random-access potential of hard disks, the reliability of CD-ROMs, and the promise of DAT-like capacity. But before you dash

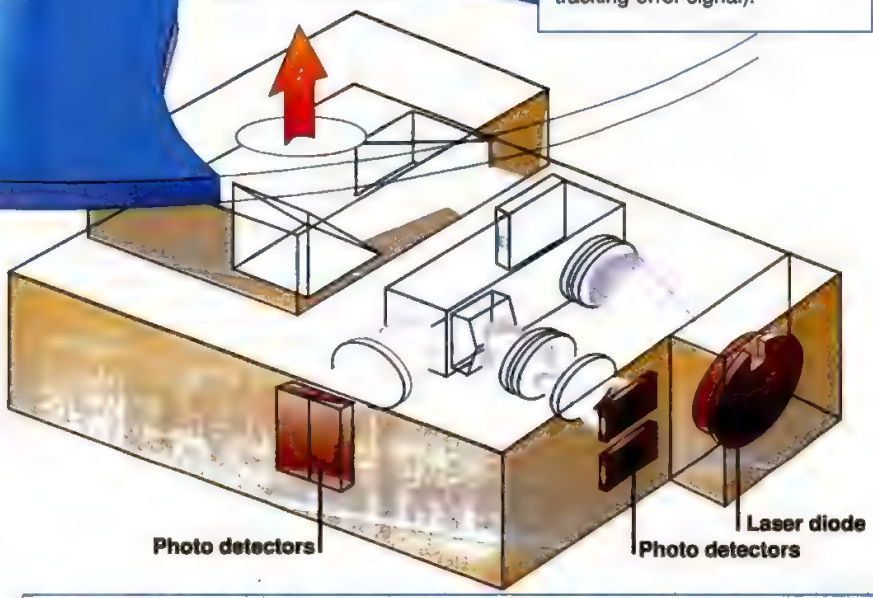
PHOTOGRAPH: MARC DAVID COHEN

HOW MAGNETO-OPTICAL TECHNOLOGY WORKS

As the name suggests, magneto-optical drives use both magnetism and light to read from and write to a disk. Writing to disk actually takes two passes: an erase pass and a write pass. Reading the disk takes only one pass and is therefore faster than writing.

OPTICAL HEAD

The optical head in a magneto-optical drive uses a series of mirrors, lenses, and prisms to direct the light it uses to read from and write to the disk. The light originates at the laser diode and follows a path to the disk. Light reflected from the disk is translated into electrical signals by photo detectors. The drive electronics then interpret those signals as data and use them to maintain focus (by way of the focus-error signal) and tracking (by way of the tracking-error signal).



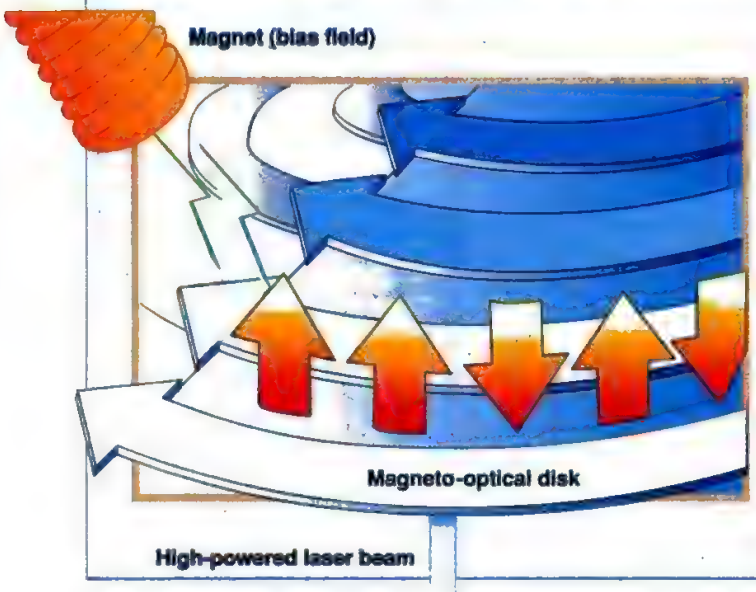
out to buy this ultimate storage solution, consider the limits of the current crop: They're expensive, they can't provide as much storage on one side of a disk as the largest hard disks, and they're slower than today's hard disks. (See the sidebar "From Floppy to Magneto-Optical: A Guide to Storage Options.")

For a complete end-user package (which includes a SCSI controller, software, and an MO cartridge as well as the drive mechanism), the 17 external MO drives reviewed here are priced roughly between $3,000 and $7,000. Compare this price range with the cost of a 300MB (roughly the average per-side capacity of an MO cartridge) hard disk, which is between $1,500 and $2,000. And a hard disk has a higher storage capacity—up to 1.2GB of on-line storage. Currently, magneto-optical drives offer a maximum of only 500MB per side. Also, your hard disk is faster than an MO drive. On average, the tested MO drives performed PC Magazine Labs' DOS Disk Access test approximately four times as slow as the hard disk on our test-bed Compaq Deskpro 386/25e. (See the sidebar "Magneto-Optical: Faster than a Floppy, Slower than a Hard Disk.") So don't toss out your trusty Winchester drive yet: For primary storage, it's still your best bet.

SECONDARY STORAGE

For other storage needs (such as secondary storage, especially for large files) MO drives may prove ideal. And for backing up your hard disk, you won't find a more reliable medium—although it is

READING AND WRITING WITH A MAGNETO-OPTICAL DRIVE



Magneto-optical drives write data using magnetism (in the form of a magnetic field called the bias field) and light (in the form of a laser beam). The recording layer on the disk stores the equivalent of binary 1s and 0s in the magnetic domains, shown here as vertical arrows to indicate polarity. The disk is designed so that the bias field by itself is too weak to change the polarity of the magnetic domains. But when a spot on the disk is heated by a high-powered laser beam, its resistance to changing polarity drops. The bias field can now change the disk area's polarity, which the drive reads as 1s and 0s. To read the disk, the drive uses a laser beam that is not hot enough to allow the bias field to change the disk area's polarity.

an expensive storage solution.

The combination of high capacity, erasability, and removability makes MO drives a good choice for any application that needs lots of disk space, such as graphics. *PC Magazine*, for example, is almost 100 percent electronically produced. A single cover can use as much as 40MB of disk space. We need to keep that graphics file on hand for months, but with an issue coming out once every two weeks, we can't tie up valuable hard disk space with magazine covers. An MO drive would be the perfect solution for this secondary-storage application.

Some other disk-hungry applications that are tailor-made for MO storage include CAD/CAM images, voice mail messages, and fax messages. However, MO drives are currently a poor choice for multimedia applications because the drives' data retrieval times are too slow. To help put their speed in context, consider that on average the drives reviewed here perform three times as fast as the floppy disk drives on our Deskpro.

Another significant application for MO drives is hard disk backup. From a strictly functional viewpoint, MO drives are a clear improvement on tape drives, since MOs are random-access devices. If your hard disk dies and you have it backed up on tape, you'll have to wait for a new hard disk before you can restore your data. If you have it backed up on an MO disk, you can keep going, albeit at a slower speed.

The removability of the MO disk makes it attractive for applications where security is key. With an MO disk, you can easily lock up your data in a safe each night. And removability can give you some of the sneakernet functionality of a floppy disk as well. Consider, for example, carrying multimegabytes of programs and data between home and office on a single lightweight 5.25-inch disk.

One final advantage of MO drives: MO technology is crash-proof because the read/write head doesn't speed across the disk (as it does for a Winchester hard disk).

LASER BEAMS AND MAGNETS

Most storage technologies are either purely magnetic (such as hard disks, floppy disks, and tape drives) or purely optical (such as WORM drives). But as its name implies, a magneto-optical drive depends on both magnetism and optics by using a magnet and laser. The drive writes data (as a pattern of magnetic fields) to a disk by using both the laser and magnet; when reading the data (by using the laser only), the MO drive interprets the effect of these fields on the reflected light.

In some ways, a magneto-optical disk works much like any other magnetic medium. The disk's recording layer is magnetic, and the drive uses a magnetic field called the *bias field* to change the magnetic polarity of areas on the disk. However, unlike purely magnetic media, the recording layer is designed so that at normal operating temperatures, the bias field is far too weak to affect the magnetic alignment on the disk. That's where the laser beam comes into play. (See the diagram "Reading and Writing with a Magneto-Optical Drive.")

Resistance to the effect of magnetic fields is known as *coercivity*, and it is one of the advantages of the MO disk over traditional magnetic media. The higher the magnetic medium's coercivity, the less likely the chance of accidental alteration by stray magnetic fields. Put a refrigerator magnet on a floppy disk and you will almost certainly scramble any data on the disk. Put that same magnet on a magneto-optical disk and nothing is likely to happen.

Of course, high coercivity also makes it more difficult to write to or erase from the disk, but you can change coercivity by controlling the temperature. The coercivity for any magnetic medium falls as temperature rises. At low temperatures, this effect is slight. However, all magnetic materials have a characteristic temperature called the *Curie temperature*, at which coercivity falls rapidly to zero.

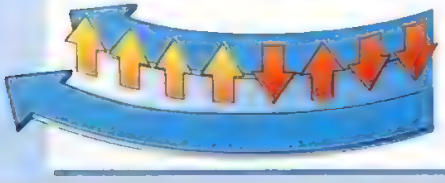
RAISING THE TEMPERATURE

The Curie temperature for magneto-optical disks is, very roughly, about 150 degrees Centigrade (300 degrees Fahrenheit). This is a far higher temperature than a disk is likely to be subjected to from normal handling, but it is low enough for a laser beam to quickly heat the recording layer above its Curie temperature. When a given spot is heated, it can then be influenced by the bias field's magnetic force, which changes the spot's magnetic polarity. The MO material then quickly cools

ERASE PASS

Writing to a magneto-optical disk takes two steps: an erase pass and a write pass. During the erase pass, all the magnetic domains align to the same polarity and represent binary 0s.

The high-powered laser beam heats each spot, which in turn allows the bias field to change the polarity of the magnetic domains. Opposite polarities attract, and as the disk passes under the bias field—whose polarity is set in one direction (down, in this case)—it changes all the magnetic domains to the opposite polarity (up, in this case).



WRITE PASS

On the write pass, the drive reverses the polarity of the bias field (up, in this case). As with the erase pass, any spot the high-powered laser heats will have its polarity changed (to down, in this case) by the bias field. On this second pass, however, the drive is selective, essentially heating up the binary 1s and leaving the 0s alone. The result is a pattern of 1s and 0s—or north and south polarities—that the drive can read and interpret as data.

READ PASS

To read from the disk, the drive uses a low-powered laser beam that does not heat the disk significantly. The read step takes advantage of a phenomenon called the Kerr effect. When a polarized light beam reflects off a metal surface in a magnetic field, the light is rotated clockwise or counterclockwise, depending on the polarity of the field. The drive detects this rotation and interprets it as data.

down and regains its high coercivity.

To write magnetic patterns on the disk, the MO drive turns its laser on and off as the disk rotates. The laser selectively heats particular spots as they pass though the bias field, thereby changing their magnetic polarities.

Since the magnetic field remains constant as the laser turns on and off, the drive can set polarity in only one direction on any given pass. To use the standard binary shorthand, it can change 1s to 0s or 0s to 1s, but it can't do both on the same pass because the bias field cannot change rapidly enough.

To get around this problem, today's MO drives use a two-pass writing scheme. On the first pass, the drive erases the data from the area it will eventually write to. During this erase pass, the laser is on continuously while the bias field changes the area's polarity to the one not used for the write mode. On the write pass, it can then create data patterns. In essence, the erase pass sets the entire area to 0s, and the write pass adds in the 1s. (Soon to hit the market are products based on new rewritable optical technologies that can handle writing in one pass. For more information on such techniques as phase change, dye polymer, magnetic-field modulation, and light-power modulation, see the sidebar "Seeking a Faster Drive: Up-and-coming Rewritable Optical Technologies.")

To read data from the disk, the MO drive takes advantage of a subtle effect of magnetic fields on light. Lasers are a coherent light source, which means that all light from a given laser is a single wavelength and is polarized; the electric component of the electromagnetic wave varies within a single plane.

FROM FLOPPY TO MAGNETO-OPTICAL: A GUIDE TO STORAGE OPTIONS

Nobody has invented a storage solution that will satisfy all PC business users, so any choice you make will involve trade-offs among capacity, cost, and speed. To help you make the best choice for your applications, we have rated each medium, from the floppy disk to the magneto-optical disk, on its ability to perform the following functions: primary storage (for programs and data that must be available on-line, when maximum speed for reading and writing is essential), secondary storage (for programs and data that you want on hand, but speed is not a critical factor), and backup (for backing up the contents of your primary storage area for safety and archival purposes).

The ratings (excellent, good, poor, or inappropriate) are based on the needs of the mainstream business user, but you may have a niche application that turns a normally poor choice into an excellent one. For example, an optical disk's removability may be more important to you (if you want your data securely locked overnight in a safe) than a hard disk's faster access times. And in a harsh environment, the rewritable optical disk's invulnerability to head crashes may be more important than a hard disk's faster speed for primary storage.

For each technology, we have included pricing and capacity information, as well as the major manufacturers of the drives and media. The table is organized in reverse chronological order.

	Date of introduction	Primary storage	Secondary storage	Backup
Magneto-optical and phase-change disks	1988	Poor	Excellent	Good
4-mm. digital audio tape cartridge	1988	Inappropriate	Inappropriate	Excellent
8-mm. helical scan tape cartridge	1987	Inappropriate	Inappropriate	Excellent
WORM disk	1986	Poor	Good	Poor
Quarter-inch tape DC-2000 minicartridge	1984	Inappropriate	Inappropriate	Excellent
Removable cartridge (Bernoulli Box)	1983	Good	Good	Good
Hard Disk (Winchester)	1974	Excellent	Inappropriate	Good
Quarter-inch tape DC-2000 cartridge	1972	Inappropriate	Inappropriate	Excellent
Floppy disk	1971	Poor	Inappropriate	Poor

N/A—Not applicable: A hard disk does not use removable media.

When polarized light reflects off a metal surface in a magnetic field, the plane of polarization is rotated—a phenomenon known as the *Kerr effect*. The direction of rotation depends on the magnetic field's polarity. For MO disks, this rotation is a scant 1 degree, but that's enough so the drive can detect it and read the patterns on the disk.

OPTICAL COUSINS

The MO drive represents the culmination of optical storage technology since 1972, when the first videodisk was demonstrated. Although designed for a different function than computer data storage, videodisk technology relies on the same ability to track and read data with lasers. And once those issues were solved for videodisks, it was a relatively short step to the compact disk and the CD-ROM.

The CD-ROM (compact-disk read-only memory), is fundamentally the same technology as the compact disk. Data on a CD-ROM is stored in patterns of physical pits in the recording surface. The pits affect the reflectivity of the surface, and the CD-ROM drive is able to read the data by detecting these changes.

Like the compact disk, CD-ROM technology is designed as a publishing medium that allows mass production of the disks. The process involves creating a master, then creating the disks by stamping them—a process similar to the one used to make records. This approach is appropriate for producing on-line encyclopedias or other reference tools, but it is not meant to let you write anything new to the disk or modify the information that is already there.

The first WORM (write once, read many) drives were introduced in the United

Major manufacturers of drive mechanisms	Price of drive subsystem	Major manufacturers of media	Maximum capacity per disk or tape	Price of media	Cost per MB
Canon, Hitachi, Matsushita, Maxoptix, MOST, Pioneer, Ricoh, Sharp, Sony	$2,700–$6,000	Asahi Chemical, Canon, Dalcel Chemical, Fuji Photo, Hitachi, Hoechst, Kasei, Kuraray, Kyocera, Maxell, Mitsubishi, Mitsui, NEC, Philips/Dupont Optical, Pioneer, Ricoh, Seiko Epson, Sharp, Sony, Sumitomo Chemical, TDK, 3M, Tosoh, Verbatim	1GB	$130–$250	$0.13–$0.25
ArDAT, GigaTrend, Hewlett-Packard, Sony, WangDAT, Wangtek	$2,500–$6,000	BASF, DIC Digital, Fuji Photo, JVC, Maxell, Sony, TDK	2.5GB	$30–$45	$0.01–$0.02
Exabyte	$7,000–$8,000	BASF, DIC Digital, Fuji Photo, Maxell, Sony, TDK	5GB	$40	$0.01
Hitachi, ISI, LMSI, Mitsubishi, Optimem, Panasonic, Pioneer, Ricoh	$2,500–$4,000	Maxell, Philips/Dupont Optical, Pioneer, Plasmon, TDK	1GB	$100–$200	$0.10–$0.20
Archive, Colorado Memory Systems, Irwin, Mountain, Wangtek	$400–$1,400	Carlisle, Sony, 3M	150MB	$30–$40	$0.20–$0.27
Iomega	$1,119–$2,499	Iomega	44MB	$90–$140	$3.18–$4.50
Conner, DEC, Fujitsu, Hewlett-Packard, Hitachi, IBM, Maxtor, Micropolis, Miniscribe, NEC, Quantum, Seagate, Western Digital	$200–$9,000	N/A	1.2GB	N/A	$7.50–$10.00
Archive, Tandberg, Wangtek	$1,000–$4,000	Carlisle, Gigatek, Sony, 3M	525MB	$35–$75	$0.07–$0.14
Chinon, Matsushita, Mitsubishi, Sony, TEAC, Toshiba	$60–$100	CAO, Fuji Photo, Maxell, 3M, Verbatim	1.44MB	$1–$2	$0.69–$1.39

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States in 1985. Like CD-ROMs, WORM disks can only be written to once. But instead of a publishing company, the user writes the data, making it a good storage solution for archival applications. There are several different ways WORM drives can use a laser to change the physical state of the disk, but they all produce a change in reflectivity. As with CD-ROMs, the drive reads data by detecting that change.

The future for WORM lies in so-called multifunction drives, which combine WORM and rewritable optical capabilities (depending on which disk you use) into one drive subsystem. Multifunction drives are beginning to come to market at prices only a couple of hundred dollars more than their rewritable-only counterparts. (See the sidebar "Multifunction Drives: The Best of Both Worlds.")

REVIEW CRITERIA

To be included in this review, a magneto-optical package had to be a complete subsystem consisting of drive, controller, software, manuals, and any other components needed to make it a plug-and-play product. Each reviewed MO drive has to follow the ISO (International Standards Organization) and ANSI (American National Standards Institute) standards for 5.25-inch 600MB rewritable optical drives. It also had to be available directly to end users as a shipping product, and of course the subsystem had to arrive at PC Magazine Labs in working condition in time for review. (Currently, there are no standards for 3.5-inch magneto-optical drives, and there were in fact no working packages available in time for review.)

Several packages not yet available for review will likely be selling by the time this story is published. These include magneto-optical subsystems from Advanced Digital Information, IPS Technology, Mitsubishi, Panasonic, Sharp, Sumo Systems, TASS International, and Tristar Technology. Hewlett-Packard offers an external drive through its distributors that's packaged with any of several interface kits. The HP drive mechanism is built by Sony to HP's specifications.

When choosing from among the 17 drives tested here, it is essential to look at the features and performance of the complete end-user package: the drive mechanism plus the SCSI controller, software, and an MO cartridge.

MECHANISM MATTERS

In this group of subsystems, there are only three drive mechanisms from three manufacturers. The eleven subsystems (from Applied Programming Technologies, FWB, MicroNet, N/Hance, OCEAN, Optima, Peripheral Land, Pinnacle Micro, Procom, Storage Dimensions, and Tecmar) use the Sony drive. The five from Consan, DynaTek, Relax Technology, Specialized Systems, and Xyxis are based on the Ricoh mechanism. And only one—the ASC MO-SS—is based on the new Maxoptix (Tahiti) mechanism. Other mechanisms will soon be available from Sharp, Matsushita (which builds Panasonic products), and Mitsubishi Electric. In addition, NEC and Toshiba are expected to join the fray shortly.

Generally, the Ricoh-based products are less expensive than their Sony-based competitors. The lowest-priced subsystem in this review is DynaTek's Ricoh-based product, priced at just over $3,000, whereas the least-expensive Sony-based product is about $4,000 from APT. The most expensive Ricoh-based package, the Xyxis XY 600RW, lists for nearly $5,000, but the cost of Sony-based systems went up to nearly $7,000 for the Tecmar LaserVault. The Maxoptix-based ASC MO-SS came in near the pricey end, at over $5,500.

When it comes to performance, we also found differences among the drive mechanisms. Although both the Ricoh and Sony mechanisms performed comparably on our reading tests, the Sony-based systems came out ahead significantly and consistently on our writing tests. The Maxoptix-based ASC MO-SS subsystem performed solidly, placing in the top five on all our tests. (See "Performance Tests: Magneto-Optical Drives.")

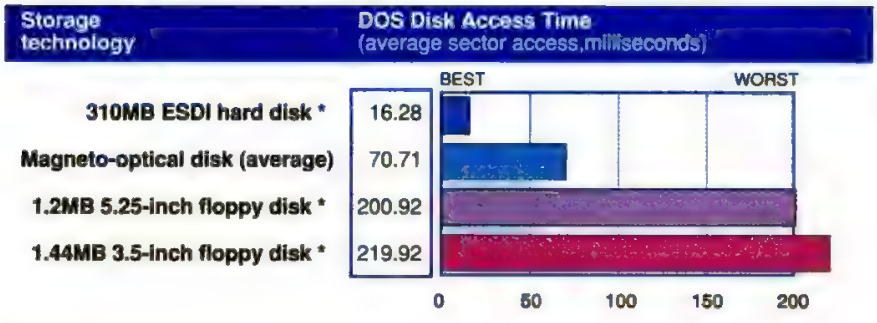
Each mechanism's average access time affected performance less than one might expect. (The average access time equals the average seek time plus the average latency—in other words, the time it takes the drive to find the right track plus the time it takes to get to the right place on the track.) The Ricoh drive, rated at 66.7 milliseconds, boasts a faster average access time than the Sony, which is rated at 107.5 ms. The Maxoptix (Tahiti) drive is rated even quicker at 48.6 ms. The Sony's faster rotation rate—2,400 rpm, compared with the Maxoptix's 2,200 rpm and the Ricoh's 1,800 rpm—account for some of the Sony's speed advantage.

INTERFACE KITS

Although pricing and performance trends tend to correspond with which drive mechanism the subsystem is built around, there are many features that differentiate these end user packages (check the fea-

MAGNETO-OPTICAL: FASTER THAN A FLOPPY, SLOWER THAN A HARD DISK

For primary storage, magneto-optical is too slow for most applications: The average magneto-optical drive subsystem reviewed here takes more than four times as long to perform PC Magazine Labs' DOS Disk Access Time test as the 310MB ESDI hard disk on our test-bed Compaq Deskpro 386/25e. But as a secondary storage device, MO may offer the right combination of speed and convenient access: MO drives perform the same test approximately three times as fast as our Deskpro's floppy disk drives.



* We are reporting test results for the device installed on our test-bed Compaq Deskpro 386/25e.

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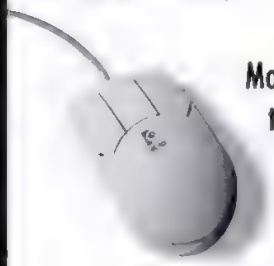

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tures table). Similarly, identical hardware will perform differently depending on the driver that comes with the package.

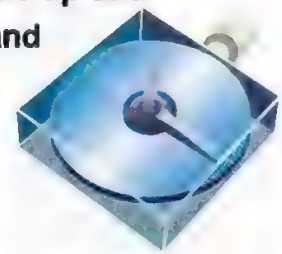
A complete storage subsystem must contain the drive mechanism plus an interface kit (which includes a SCSI controller and software) and an MO cartridge. The controller and the driver are especially significant; for example, a 16-bit controller will yield better performance than an 8-bit controller. Not all vendors sell the components in one complete subsystem package, but throughout this article, we are considering the whole product—and the price it takes to get there. The reviews reveal which vendors offer the subsystem piecemeal.

The features table provides much information on the interface kits, including who supplies the SCSI adapter, whether it is 8-bit or 16-bit, what utilities are included in the interface kit, and who writes the software. You will see such familiar names as Adaptec, Corel, and Western Digital on the table.

All the packages have a low-level formatting utility and a partitioning utility, which together let you prepare a new disk for use. However, major similarities end there. Some packages are limited to creating one partition on a disk, so you may be forced into having a single 300MB logical drive, whether that matches your work habits or not. If you prefer to divide

SEEKING A FASTER DRIVE: Up-and-coming Rewritable Optical Technologies

Wondering where magneto-optical drives are going in the future? *PC Magazine* explores the up-and-coming phase change, dye polymer, and light-power modulation technologies, which all promise greater MO speed and reliability.



by M. David Stone

Magneto-optical drive subsystems are far slower at writing data to disk than are hard disks, primarily because they have to do it in two passes. Not surprisingly, the hot topic nowadays is the search for a one-pass, or direct-write, rewritable optical technology.

Current MO drives write data to disk by performing an erase pass, which sets the entire write area to a single polarity, followed by a write pass, which sets some domains to the opposite polarity. This takes two passes because both polarities are determined by a magnetic field called a *bias field*, which cannot change quickly enough to write both polarities to disk on a single pass. The current polarity of the bias field is determined either by a permanent magnet that takes a significant time to rotate to a new orientation, or by an electromagnet that takes too long to change polarity.

The most-often mentioned alternatives to the two-pass problem are *phase change*, which is already available in a Matsushita drive mechanism sold by Panasonic and other companies, and *dye polymer*, which is still under development. In addition, there are two lesser-known alternatives, both of which use extensions of magneto-optical technology: *magnetic-field modulation* and *light-power modulation*.

PHASE CHANGE AND DYE POLYMER

Phase change and dye polymer technologies have both been available for some time in WORM (write once, read many) drives. Both use a laser to heat the recording layer and cause a physical change to the disk that affects its reflective properties. The drive reads data patterns by bouncing light off the disk to detect those changes. The difference between the WORM and rewritable technologies is that the latter lets you reverse the change as well.

Phase change uses a media substance that can switch between amorphous and crystalline states. Zap a spot with a laser set to a specific power level, and the spot either switches to or stays in the crystalline state. Zap the spot with a higher-power beam, and the spot essentially switches to or stays in the amorphous state; more precisely, the laser heats the spot to its melting point, after which it cools down to the amorphous state.

Dye polymer media, on the other hand, depends on dyed plastic layers. The rewritable version of this technology uses two layers, each of which is sensitive to a different frequency, or color, of light. To write to the disk, the drive uses a frequency that the top layer ignores but to which the bottom layer reacts. The bottom layer swells and creates a small bump that affects the disk's reflective properties. To erase the bump, the drive uses a different frequency that affects only the top layer, smoothing the bump out.

Both the phase change and dye polymer technologies can write data in a single pass. The drawback here is that writing and erasing puts a physical stress on the medium, which in turn limits its life. The disks for Panasonic's phase change drive, for example, are rated at 100,000 read/write cycles—compared with 1,000,000 read/write cycles for MO disks.

Panasonic's solution is to have the drive automatically relocate data when it detects a questionable sector on the disk. The long-term practicality of such a scheme has yet to be tested, since the drive has only been available since December 1990. However, Panasonic is confident that the approach will make phase change drives as reliable as anything else, and the company claims the equivalent of 1,000,000 read/write cycles. If—or when—dye polymer drives reach the marketplace, their manufacturers will probably use a similar scheme to increase reliability.

MAGNETIC-FIELD MODULATION

Sony has demonstrated a thin-film magnetic head that can change polarity in

ILLUSTRATION: DAVID FOSTER

large drives into smaller logical units of about 100MB each, you will want a package that lets you create multiple partitions, either with its own software or through DOS's FDISK.

At the other extreme, you may have a problem with too many partitions if you are using a version of DOS 3.*x* that's limited to 32MB partitions. Some of these packages offer patches for DOS 3.*x* that will let you create larger partitions—typically up to the full available size—on the MO disk. And if you are using Compaq DOS 3.31, which allows for 300MB partitions (much like DOS 4.01 does), note that you may need special support in the MO package.

If you plan to use the MO drive for backing up your hard disk, you will probably want a package that offers a special backup mode. Tecmar, for example, offers a feature it calls a virtual tape drive. Such backup modes are often faster than using, say, XCOPY, because they don't spend time updating the file-allocation table. However, such backup modes may do away with the random-access capability, so you can't use the backed up data until you restore it to a hard disk.

Also note that some packages have convenience tools, such as optional booting from the MO drive or a background formatting capability that will format new MO disks while you keep using your system. Background formatting is not important on systems that can format new disks quickly, but it can be critical for units that take 20 to 40 minutes to format a new disk.

Another feature that you may want to consider is the ability to move data across platforms. For example, the backup mode on the Tecmar drive also doubles as a data interchange feature, allowing you to move between a DOS system and a Mac system. The following reviews provide details on the software that comes with the subsystems.

COMPATIBILITY AND STANDARDS

As often happens with new technologies, the first crop of MO drives were mostly incompatible with each other—despite having two standards bodies working on specs.

Lack of compatibility is not an issue if you want to use any given disk on only a single computer or network. But the mere fact that MO disks are removable carries with it a promise of interchangeability. Ideally, MO drives should let you exchange disks as easily as you can now exchange floppies. And that requires standards.

The relevant standards are set by ISO and ANSI. Unfortunately, those standards are not yet completely settled. In fact, there is an important difference between the two standards. And if you're interested in interchangeability, you need to understand the difference.

The ISO standard allows for either of two incompatible formatting schemes: *continuous composite servo* (CCS) and *sampled servo* (SS). At the moment, CCS is by far the more popular format, in part because it was first to market. Also adding momentum to CCS is the fact that the ANSI standard allows for CCS format only. So any ANSI-compatible drive is ISO compatible, while a drive that claims ISO compatibility may not be ANSI compatible.

only a few nanoseconds. A drive built around this head can change the magnetic field, or *modulate* it, quickly enough to keep up with the data stream. If you simultaneously pulse the laser while selecting north and south polarities, you can write both polarities to disk in a single pass.

This magnetic-field modulation, or MFM, is similar to the recording schemes used by hard disks. However, the head is still far enough from the disk to eliminate the possibility of a crash. As a bonus, Sony says that its MFM technology will be able to read from current MO disks, though it is not clear whether it will be able to write to them. According to Edward Rothchild, a longtime observer of optical technology with Rothchild Consultants, Hitachi and Fujitsu are working on similar MFM schemes. Rothchild projects that MFM magneto-optical drives may be available within two years.

MODULATING THE LIGHT

Another alternative technology is variously known as *light-intensity modulation, light-power modulation,* and *laser-power modulation.* First proposed by Nikon and currently being developed by Sony and IBM, according to Rothchild, light-intensity modulation gets its name from its use of three different light intensities—one low-powered read mode, one medium-powered write mode, and one high-powered write mode.

Light-power modulation needs two magnets in the drive and a more complex disk structure than current MO disks. The two magnets include a bias magnet, as you will find in today's MO drives, and an initializing magnet that sits earlier in the path than, and is set to the opposite polarity from, the bias magnet. In the simplest approach to light-power modulation, the disk has two layers: one for initializing and one for recording.

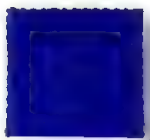
The initializing layer is constructed so that the initializing magnet can affect its polarity without needing a laser. As a result, when an area of the disk passes over the initializing magnet, the layer will change to or stay at a given polarity; think of the layer as a binary 0.

When the same area reaches the laser and bias magnet, one of two things happens. If the laser zaps the disk with a medium-power laser, the beam will generate just enough heat to image the magnetic field of the initializing layer on the recording layer. In short, the recording layer will also store a binary 0. However, if the laser zaps the spot with a high-power beam, the layer will reach its Curie point (about 150 degrees Centigrade or about 300 degrees Fahrenheit) and will set its magnetic polarity based on the bias magnet. Basically, it will be set to the opposite polarity, a binary 1. By selecting the appropriate laser power, the drive can then write both polarities on a single pass.

The only direct-write scheme that has so far been incorporated into a finished product is the phase change technology in the Matsushita drive. But with so many up-and-coming alternatives, the ultimate victor is far from clear. ■

Ironically, the difference bet
and the second best ha

Yes, the ColorPoint offers top-notch color It also offers superior performance in other respects. But the best news of all is the price – $6,999 for the A (letter) size and $9,999 for the B (tabloid) size



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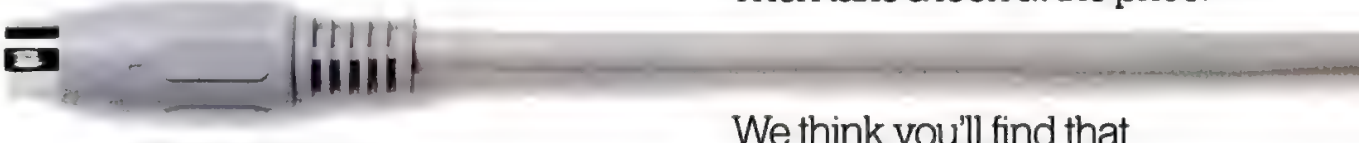
Then take a look at the price.



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SII
Seiko Instruments

Because CCS is currently the more popular format, and because only CCS drives can be both ANSI and ISO compatible, we've focused this overview on 5.25-inch-drive packages that use CCS format. Note, however, that proponents of the SS approach are quick to claim it as the superior choice. The current relationship between CCS and SS formats is reminiscent of the battle between VHS and Betamax formats, except that it is far too early to predict the winner. For now, simply keep in mind that these two are incompatible formats; if you want interchangeability between two systems, you will need the same type of drive on each system.

SECTOR SIZE

Unfortunately, the formatting scheme is not the only problem with interchangeability; the disk's formatted sector size presents another problem. The ISO and ANSI standards define two variations of MO disks, with either 512 or 1,024 bytes per sector. The chief advantage to using 1,024-byte sectors is additional capacity,

PC MAGAZINE EDITORS' CHOICE

- **FWB HammerDisk600S**
- **Tecmar LaserVault**

Magneto-optical drives are still a niche product. There were 17 drives available for this roundup (and at least eight more products weren't ready in time from Advanced Digital Information, IPS Technology, Mitsubishi, Panasonic, Sharp, Sumo Systems, TASS International, and Tristar Technology). But even with such a variety of vendors, these subsystem packages (which had to include the drive, software, controller, and a cartridge) still weren't polished enough to push this category into the mainstream. With this in mind, we selected two drives as Editors' Choice winners—the Tecmar LaserVault and the FWB HammerDisk600S—and awarded one honorable mention to the DynaTek ROS600.

For the moment, MO drives offer random-access retrieval speed (like hard disks), rather than the sequential-access speed of other removable devices; they have a high storage capacity (but not as high as some hard disks); and of course they are removable (you can pop out the disks for easy transportation or lock them up somewhere safe for the night). These features provide unique advantages for applications such as desktop publishing with memory-hogging graphics, or for secondary storage (to keep on-line those programs for which retrieval speed is not an issue), and for backup purposes. But judging by the drives seen here, most MOs are still plagued by immature design and packaging.

We required that all review units conform to the ISO and ANSI standards for 5.25-inch optical drives. But even with this filter and the fact that there are only three major manufacturers of rewritable-optical drive mechanisms (Sony, Ricoh, and Maxoptix), you generally could not pop a disk out of one vendor's drive and use it in another unit. If you require enough of this technology to warrant purchase of more than one drive, make sure they're from the same vendor. And when judging between drives, look not only at the usual price-versus-performance issue but also at the whole package—the software included and especially the ease-of-use factor.

If you have the need, the money, and the necessary know-how, you should buy the Tecmar LaserVault. Although this unit was the most expensive one we tested ($6,885), it was also a consistently strong performer and perhaps more importantly provided the most-complete and feature-laden package. Bundled with excellent backup and automatic installation software, the LaserVault was as close to plug-and-play as these drives got. It also provided all the extras—support for 1,024-byte-sector disks, data exchange between DOS and Macintosh environments, and the ability to handle multiple operating systems on a single disk. If you can afford the price tag, this is the subsystem to buy.

An Editors' Choice award also goes to FWB's HammerDisk600S. This unit beat the Tecmar LaserVault on overall performance, but it did not come quite as well-equipped or as neatly packaged. Even though you have to buy this $6,085 system one component at a time, the effort is well worth the results. A fast unit with competent software utilities (though nothing like the LaserVault's *LaserBack* backup software), the only thing the HammerDisk600S cannot handle that the LaserVault can is 1,024-byte-sector disks. If you don't need all the extras the LaserVault provides and want a little more speed, the HammerDisk600S is your best choice.

An honorable mention goes to DynaTek's ROS600. This was the least expensive unit here at only $3,245 and was surprisingly well put together. Although it suffered from mediocre performance and couldn't handle cross-platform data exchange or multiple operating systems on a single disk, the DynaTek proved a solid value, delivering relatively easy installation, excellent software utilities, and 1,024-byte-sector formatting capability.

A final drive worth mentioning is the N/Hance W6501, which is an extreme example of the MO industry's current state. The W6501, with a unique and powerful driver, proved to be the fastest drive on our most important tests. But due to design flaws in that same driver, the subsystem was entirely incompatible with another test. Most of these drives display this kind of inconsistent performance. They excel at a few things but end up with inferior results somewhere else. Consistent quality, ease of use, and solid support should be key terms for anyone who is currently thinking of investing in today's magneto-optical technology.

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CIRCLE 161 ON READER SERVICE CARD

with about 325MB per side compared to about 300MB for the 512-byte-sector disks. However, if you have a large number of small files rather than a few large files, much of this extra capacity may be tied up as wasted space. And since DOS normally expects 512-byte sectors, the 512-byte-sector disks are easier to write drivers for.

All the drive mechanisms for the MO subsystems reviewed here can read from and write to disks with either sector size. However, most of the complete packages cannot. Of the 17 reviewed MO packages, 12 are limited to disks with 512-byte sectors. The five that support both formats are from Advanced Storage Concepts, Applied Programming, DynaTek, N/Hance, and Tecmar. Being able to read from and write to both formats obviously maximizes interchangeability with other drives. However, the 512-byte-sector disks serve as a universal common denominator among all these subsystems.

Interestingly, of the five subsystems that can handle both sector sizes, our tests show no consistent performance differences between the two types of drive. On any given test, some units perform better with 1,024-byte-sector disks and others perform better with 512-byte sectors. And for any given MO package, the performance difference between the two sector sizes can be anything from trivial to significant.

Storage capacities will increase, and subsystem prices will fall to below $2,000.

Even if you limit yourself to subsystems that follow both the ISO and ANSI standards, and even if you use 512-byte-sector disks exclusively, you're still not guaranteed interchangeability across MO subsystems. The ISO and ANSI standards define only the physical format for disks, not the logical format for writing data. To guarantee interchangeability, make sure the drives are using the same software; the features table will guide you.

In an effort to promote interchangeability, ANSI is already working on a standard to specify the logical format that would work with current and with future MO drives. That means you can buy a 5.25-inch drive now without worrying about its becoming obsolete in the near future—though you will likely need new driver software. But for 3.5-inch drives, the physical format standards are still very much under discussion.

One more nonstandard feature worth mentioning is a proprietary recording option that boosts disk capacity for the Maxoptix drive to over 500MB per side. The ISO and ANSI standards use a technique called *constant angular velocity* (CAV). The Maxoptix drive can use CAV with ISO-standard disks, but it is also capable of using a proprietary technique called *zoned constant angular velocity* (Z-CAV) with special Z-CAV disks. The Z-CAV scheme takes advantage of the larger outer tracks on a disk in order to store more data.

The additional capacity on the Z-CAV disk is a clear advantage, though it defeats

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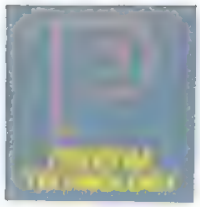

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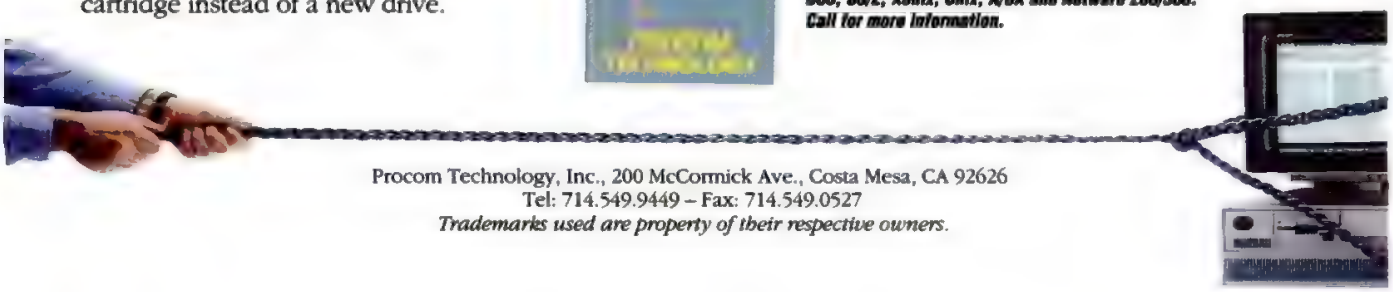

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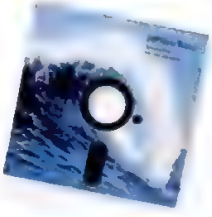

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the purpose of having a standard format. Maxoptix is currently leading an effort to establish an interchangeability standard for Z-CAV disks as well.

MORE GIGABYTES, FEWER DOLLARS

Despite the hassles that any nascent technology brings, the future for MO looks bright. Edward Rothchild of San Francisco's Rothchild Consultants Inc. has been following optical technology since 1974. Rothchild projects that by the end of this decade, storage capacities will have increased by a factor of 30, yielding 10 gigabytes on one side of a 5.25-inch disk. He also feels that within two years, subsystem prices will fall to below $2,000 (based on volume increases alone), and disk prices should also fall (the current range is from $150 to $250).

In the near term, most observers expect 3.5-inch drives to be the big news for 1991. Even with ISO and ANSI 3.5-inch standards still being argued over, at least three companies—Sharp, Ocean Technologies, and Pinnacle—have already announced or are shipping 128MB single-sided 3.5-inch packages. And IBM has announced for the Japanese market its own 3.5-inch 128MB MO drive. Rothchild also expects to see 3.5-inch drives this year from Panasonic, Ricoh, Sony, and possibly others as well. So if you're not interested in an MO drive just yet, odds are you will still wind up with one eventually as prices inevitably fall and performance and capacity increase.

For the moment, MO drives remain a niche product. If you must have large-capacity random-access storage capability, or if you need a backup option that offers random access to the backed-up files, an MO drive may well be worth getting. And if you are interested in purchasing one now, you should be able to find an appropriate choice from among the 17 drives reviewed here.

ADVANCED STORAGE CONCEPTS INC.

ASC MO-SS

by Winn L. Rosch

The ASC MO-SS is the only tested drive based on the Maxoptix (Tahiti) drive mechanism, which has a 48.6-milliseconds average access time. Even though this subsystem didn't make a solid first impression, the expensive $5,595 ASC MO-SS delivered quick operation and a high storage capacity.

Thanks to its ability to handle 1GB non-ISO cartridges as well as ISO 512-byte- and 1,024-byte-sector cartridges, the ASC MO-SS's performance was fairly solid. On the DOS Disk Access benchmark test, the subsystem proved to be the fastest of all the tested drives, and its performance on the File Access tests was also exemplary. The ASC MO-SS finished second on the XCOPY from Winchester to Magneto-Optical test and lagged only a little further behind when XCOPYing from the MO to the Winchester—all told, a strong set of consistent results.

The biggest black mark against the ASC MO-SS is a lack of clear user instructions. Advanced Storage Concepts (which also offers magneto-optical subsystems based on Sony's SMO-C501 mechanism and on Hewlett-Packard's C1711A, which Sony builds for HP) supplies only the manufacturer's OEM instructions for the unit and a few printout sheets of their own for the host adapter and software. Furthermore, the subsystem must first be booted under DOS 3.3, with which you can set the controller to properly run under DOS 4.01. DOS is currently the only operating system supported by the ASC MO-SS.

If you're somewhat experienced with SCSI devices, you should have few problems with the software installation. An installation program supplied by ASC automatically edits the host computer's CONFIG.SYS file when adding its driver. If the program detects that the cartridge you have loaded into the drive is not properly prepared, it prompts you to initialize it—a process that requires but a few seconds. You may even get the system to boot from the optical medium if you use 512-byte-sector cartridges.

Physical installation of the ASC86 host adapter supplied with the ASC MO-SS should be easy. There are no jumpers to move, but we had to remove one of the 50-inch SCSI connector's bail wires on the half-length board's retaining bracket before the adapter could tightly squeeze into an expansion slot. Host adapters from ASC are available that match Micro Channel computers or add floppy disk control circuitry (a $50 option).

ASC provides a 6-foot cable that extends from the adapter to a matching jack on the rear of the 6.75- by 7.5- by 12-inch (HWD) Maxoptix drive. A separate external SCSI terminator is also supplied. The ASC host adapter, which uses a 16-bit interface, also provides a header for internal drive installation.

If you're just looking for well-matched components, the ASC MO-SS will give you what you want. As a subsystem, however, its current incarnation suffers from immature software design and inattention to detail; only experienced users should consider this subsystem.

FACT FILE

ASC MO-SS
Advanced Storage Concepts Inc., 10855 Rockley Rd., Houston, TX 77099; 713-879-4090
List Price: With interface kit and cartridge, $5,595; additional media, $300.
Requires: DOS 3.3 or later, 640K RAM.
In Short: The only Maxoptix-based system reviewed, the ASC MO-SS delivered excellent performance, though its packaging was a little skimpy.

CIRCLE 004 ON READER SERVICE CARD

APPLIED PROGRAMMING TECHNOLOGIES

APT Odessa ROS-3250EIS

by Winn L. Rosch

Building on the sturdy foundation of a 107.5-millisecond (average access time) Sony SMO-S501 magneto-optical drive, Applied Programming Technologies adds its own host adapter and software to create the APT Odessa ROS-3250EIS. Unfortunately, the Sony drive is the most solid part of the subsystem; the rest of the Odessa is slow and a little more quirky than a $3,995 product should be—even if it is one of the least expensive drives here.

Applied Programming Technologies does nothing to disguise the Sony drive; the Odessa wears the Sony logo and sits in the same 5- by 8.25- by 12.25-inch metal case. All necessary SCSI options are built-in, so changing the line termination or adding termination power is merely a matter of flipping a DIP switch. A subsystem based on a Ricoh MO drive is also available for $3,995.

The half-length Applied Programming Technologies SC-1000 host adapter is based on an NCR SCSI chip and fits either

FACT FILE

APT Odessa ROS-3250EIS
Applied Programming Technologies, One Hollow Ln., #313, Lake Success, NY 11042; 800-486-3662, 516-365-1098.
List Price: With interface kit and cartridge, $3,995; additional media, $225.
Requires: DOS 3.2 or later, 512K RAM.
In Short: The Sony-based Odessa ROS-3250EIS, while it has a low price, is marred by moderate performance and a quirky driver that does not quite conform to DOS.

CIRCLE 606 ON READER SERVICE CARD

8- or 16-bit ISA sockets. (A Micro Channel version is also available as a $200 option, but it doesn't support all the software features of the ISA model.) Because the board itself uses an 8-bit connection, a 16-bit slot only allows a wider selection of interrupt assignments.

In fact, the only hardware setup you will need to change during installation is the interrupt jumpers on the host adapter. The supplied 32-inch cable connects the 25-pin D-shell jack on the host adapter to the 50-pin SCSI jack on the Sony drive.

While the APT board allows the Sony drive to boot the host computer (except in the MCA version), it requires an odd system configuration. You have to carve out a special 360K boot partition from the MO disk and then copy the files from a boot floppy. The APT software can slice up the rest of the disk into 15 partitions ranging from 1MB to the full cartridge capacity. The subsystem accommodates ISO 1,024-byte-sector and 512-byte-sector cartridges.

You can set up the Odessa subsystem automatically with the do-everything utility called MOD. The Odessa ROS-3250EIS requires a software driver, which MOD will graciously install in the host computer's CONFIG.SYS file. The program will also initialize, partition, and format cartridges. The 1,024-byte-sector cartridge supplied with the evaluation unit came preinitialized, which saved the 32-minute (pour yourself a cup of coffee) initialization process. The subsystem operates under DOS 3.3 or 4.0, but it is not compatible with OS/2, Unix, or network operating systems.

You'll want to pull out the daily paper while running the Odessa: It required an extraordinary length of time to perform PC Magazine Labs' backup and restoration tests. Its DOS File Access test results were average, as was its DOS Disk Access time. Performance increased only slightly when using 1,024-byte-sector disks.

Applied Programming Technologies covers the Odessa subsystem with a one-year warranty. Although the Odessa ROS-3250EIS carries a low price and manages to muddle through, other competitors can more quickly accomplish the same tasks and better conform to the DOS standard.

MAGNETO-OPTICAL DRIVE SUBSYSTEMS: SUMMARY OF FEATURES

Products listed in ascending price order

The 17 magneto-optical drive subsystems reviewed here are external SCSI devices. They all comply with the ISO/ANSI standards for 5.25-inch rewritable optical drives, including support for 512-byte sectors. In each case, we list the price for the tested configuration, which includes the drive plus an interface kit (a SCSI controller and DOS driver) and one media cartridge.

	DynaTek ROS600	Relax Optical 600 Plus	Consan RS600/N	APT Odessa ROS-3250EIS	SST Storage Stak II	OCEAN Tidalwave 650	PLI Peripheral Infinity Optical	Xyxis XY 600RW
List price of tested configuration	$3,245	$3,377	$3,495	$3,995	$4,422	$4,495	$4,799	$4,995
PHYSICAL CHARACTERISTICS								
Mechanism manufacturer	Ricoh	Ricoh	Ricoh	Sony	Ricoh	Sony	Sony	Ricoh
Average access time (ms.)	66.7	66.7	66.7	107.5	66.7	107.5	107.5	66.7
Dimensions (HWD, in inches)	5 x 10 x 10	4 x 10 x 11	5 x 10 x 13	5 x 8 x 12	14 x 10 x 13	5 x 10 x 11	5 x 10 x 12	6 x 10 x 13
Tested interface	16-bit	8-bit	16-bit	8-bit	16-bit	8-bit	8-bit	16-bit
Size of interface board	Half-length	Half-length	Full-length	Half-length	Full-length	Half-length	Half-length	Half-length
Board manufacturer	DynaTek	Relax Technology	Procomp USA	APT	Western Digital	Future Domain	PLI	Adaptec
MEDIA								
Capacity (512-byte sectors, both sides)	1GB	570MB	596MB	560MB	650MB	564MB	562MB	600MB
Maximum partition size (512-byte sectors)	320MB	285MB	327MB	280MB	281MB	282MB	281MB	287MB
1,024-byte sectors supported	■	❑	❑	■	❑	❑	❑	❑
SOFTWARE								
DOS device driver size	16K	13K	62K	16K	16K	7K	17K	22K
DOS device driver required	■	■	■	■	■	■	■	■
Other operating systems supported	OS/2, Mac, Unix	Mac, Unix	OS/2	None	OS/2, Mac, Unix	Mac, Unix	Mac	OS/2, Mac, Unix
Install utility	None	Trantor	Procomp USA	APT	Columbia	OCEAN	PLI	Xyxis
Format utility	DynaTek	Trantor	Procomp USA	APT	Columbia	OCEAN	PLI	Xyxis
Backup utility	DynaTek	None	None	APT	Columbia	None	PLI	None

PC—Editors' Choice ■—Yes ❑—No

CONSAN INC.

Consan RS600/N

by Winn L. Rosch

A high-powered controller isn't enough to deliver high performance, at least in the case of the RS600/N from Consan Inc. The low-priced $3,495 storage subsystem proved to be one of the most laggardly of the tested magneto-optical drives on PC Magazine Labs' write tests, despite having a SCSI host adapter based on an Intel 80C188 microprocessor. The test subsystem was further marred by an ill-natured installation program that may prove confounding if you have never mixed SCSI and disk drives before.

Based on a 66.7-millisecond (average access time) Ricoh RO-5030EII MO drive, the Consan subsystem fits in a cabinet that measures 5.25 by 9.25 by 13 inches and connects to its controller through a 32-inch cable with a standard 50-pin SCSI connector at the drive end and a 37-pin D-shell on the controller side. The RS600/N also uses an external SCSI terminator, which is supplied with the unit. The host-adapter board itself requires a full-length full-height AT expansion slot and uses a 16-bit interface. A Micro Channel version is also available for $180. The Consan RS600/N supports only 512-byte-sector disks.

Consan puts its host adapter's microprocessor brain to work on compatibility, and it is able to match DOS, OS/2, and Xenix as well as the latest versions of Novell's *NetWare*. The board is a Procomp USA (Cleveland, Ohio; 216-234-6387) F-DCB SCSI host adapter that features its own boot BIOS and floppy disk drive controller; this allows the RS600/N to be used as primary system storage. There is also a SCSI connector that allows for internal installation of drives.

FACT FILE

Consan RS600/N
Consan Inc., 14625 Martin Dr., Eden Prairie, MN 55344; 800-229-3475, 612-949-0053.
List Price: With interface kit and cartridge, $3,495; additional media, $155.
Requires: DOS 2.0 or later, 640K RAM.
In Short: Though this inexpensive Ricoh-based system conforms to the DOS standard and is married to an Intel 80C188 microprocessor, the Consan RS600/N has problems with installation and delivers only laggardly performance.

CIRCLE 606 ON READER SERVICE CARD

Notwithstanding its BIOS and microprocessor, the RS600/N requires you to install a 62K software driver in your CONFIG.SYS file. The driver does not prevent programs that use direct BIOS access from recognizing the subsystem.

The installation process was complicated not only by a faulty automatic in-

Pinnacle REO-650	Procom MEOD650/E	SD LaserStor Erasable Optical 650 MB	N/Hance W6501	MicroNet SB-SMO/DOS	Optima Concorde 600MO	ASC MO-SS	PC FWB HammerDisk 600S	PC Tecmar LaserVault
$5,239	$5,294	$5,295	$5,450	$5,479	$5,590	$5,595	$6,065	$6,885
Sony	Sony	Sony	Sony	Sony	Sony	Maxoptix (Tahiti)	Sony	Sony
107.5	107.5	107.5	107.5	107.5	107.5	48.6	107.5	107.5
6 x 8 x 13	7 x 8 x 12	6 x 8 x 15	5 x 8 x 12	7 x 8 x 12	4 x 11 x 10	7 x 8 x 12	5 x 10 x 10	5 x 8 x 12
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Full-length	Full-length	Three-quarter-length	Full-length	Half-length	Three-quarter-length	Half-length	Three-quarter-length	Full-length
Western Digital	Procom	Adaptec	Adaptec	MicroNet	Optima	ASC	Always	Adaptec
600MB	588MB	562MB	594MB	586MB	564MB	596MB	574MB	1GB
281MB	291MB	281MB	297MB	293MB	282MB	298MB	287MB	322MB
❑	❑	❑	■	❑	❑	■	❑	■
35K	7K	16K	130K	10K	11K	19K	20K	36K
❑	■	■	■	❑	❑	■	❑	■
OS/2, Mac, Unix	OS/2, Mac, Unix	OS/2, Mac, Unix	Unix	OS/2, Unix	OS/2, Mac, Unix	None	OS/2, Mac, Unix	OS/2, Mac, Unix
Columbia	Procom	SD	N/Hance	MicroNet	Optima	ASC	FWB	Tecmar/ Adaptec
Columbia	Procom	SD	N/Hance	MicroNet	Optima	ASC	None	Tecmar/ Adaptec
None	None	SD	N/Hance	None	None	None	None	Tecmar

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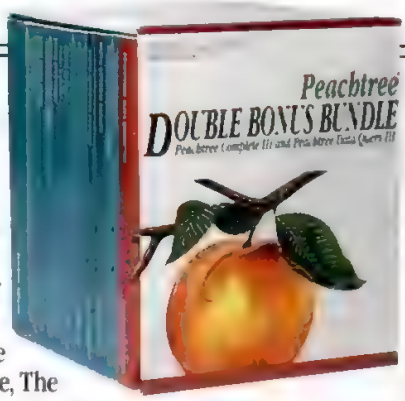

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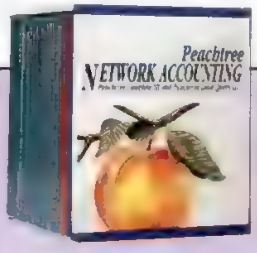

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CIRCLE 358 ON READER SERVICE CARD

PERFORMANCE TESTS: MAGNETO-OPTICAL DRIVE SUBSYSTEMS

PC LABS

Drive systems with the Sony mechanism write faster than those equipped with the Ricoh mechanism, but both types of systems perform comparably when reading. The Maxoptix-based ASC MO-SS drive turned in excellent results, but on our most important tests, the real speed demon turned out to be the Sony-based N/Hance W6501 with its proprietary driver.

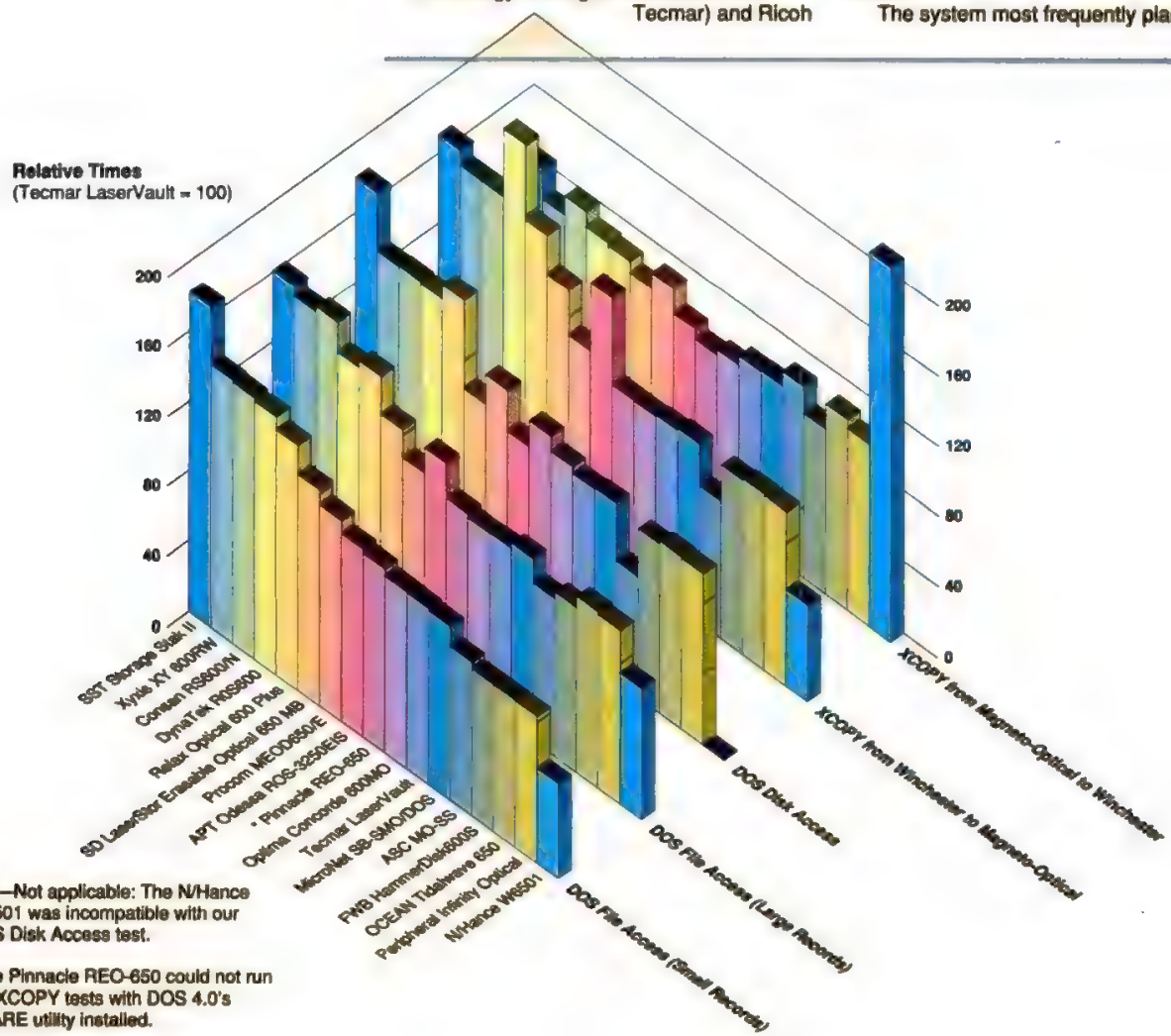
TESTING ANALYSIS

The most important tests to look at when comparing the 17 magneto-optical drive subsytems reviewed here are the DOS File Access and XCOPY tests. Each DOS File Access test is a combination of file creation, reading, and writing times for small records (database-like files) and large records (program-like files). The XCOPY tests indicate where a storage system's strengths lie—either in writing to or reading from an MO drive. The slightly less crucial DOS Disk Access test indicates a drive mechanism's rotational speed and head-stepping time.

The 17 drives reviewed here are differentiated mainly by the drive mechanisms they employ. The two most popular mechanisms are manufactured by Sony (used by 11 of the tested drives: those from Applied Programming Technologies, FWB, MicroNet, N/Hance Systems, OCEAN Microsystems, Optima Technology, Peripheral Land, Pinnacle Micro, Procom Technology, Storage Dimensions, and Tecmar) and Ricoh (used by five of the tested drives: those from Consan, DynaTek Automation Systems, Relax Technology, Specialized Systems Technology, and Xyxis). In four of the five tests, the drive systems equipped with the Sony mechanism were faster than the systems equipped with the Ricoh mechanism. This result is due in part to the higher rotational speed of the Sony mechanisms and a shorter head-latency period.

The differences between the two mechanisms showed up during the XCOPY from Winchester to Magneto-Optical test: All the Ricoh mechanism–equipped drives took significantly longer to write than those equipped with the Sony mechanism. The Sony's faster rotational speed and shorter head-latency period speeds up the two-pass writing process employed by all MOs. The XCOPY from Magneto-Optical to Winchester results, on the other hand, were so close and evenly distributed that neither mechanism came out a clear winner.

The system most frequently placing in



N/A—Not applicable: The N/Hance W6501 was incompatible with our DOS Disk Access test.

*The Pinnacle REO-650 could not run the XCOPY tests with DOS 4.0's SHARE utility installed.

the top five—the ASC MO-SS—is unique in that it is the only tested drive that uses a Maxoptix (Tahiti) drive mechanism. It had the fastest DOS Disk Access time and the second-fastest time for the DOS File Access (Large Records) and XCOPY from Winchester to Magneto-Optical tests. Its scores indicate that the Maxoptix mechanism operates at a higher rotational speed, hastening the two-pass writing process.

On our two most important tests, the fastest MO package came from N/Hance. The N/Hance W6501 employs a Sony drive mechanism, but it also has a driver that behaves as a parallel-file system; the driver introduces a great speed advantage, especially when writing to the MO. This performance is lost, however, when reading back information, as the parallel-file system's overhead slows down the data transfer. (This slowdown is not too important if the MO is used for archival purposes.) Additionally, the N/Hance W6501 driver would not work with our DOS Disk Access test because it could not properly handle interrupt 25h calls. Because of this, any program that needs to request device-specific information (such as the number of bytes or tracks per sector or the number of sectors) will have a problem with this system. So while the mechanism is an important component when considering an MO, the device driver's efficiency and performance characteristics are also critical.

Please note that we removed SHARE from the AUTOEXEC.BAT file when running the Pinnacle REO-650 through the XCOPY tests. SHARE allows old DOS applications to read and write to partitions larger than 32MB. We were unable to copy information from the Pinnacle to the hard disk with SHARE installed; the system consistently crashed while trying to copy a file larger than 1MB. Calls to the company failed to provide an explanation. With SHARE removed, the drive performed the XCOPY without a problem. (For further information, see the Pinnacle REO-650 review in this issue and the Tutor column in *PC Magazine*'s March 12, 1991, issue.)

HOW WE TESTED

PC Magazine Labs tested the drives on a Compaq Deskpro 386/25e equipped with 4MB of RAM, a 310MB ESDI hard disk with a Compaq disk controller, and built-in VGA. Compaq DOS 4.01 was the operating system used, and except for the device drivers necessary to allow the system to recognize the magneto-optical drive, the CONFIG.SYS's FILES and BUFFERS were set to 20. In addition to setting a prompt and path in the AUTOEXEC.BAT, we also ran SHARE.EXE, as is recommended for large-capacity media using DOS 4.01. We split the hard disk into two 155MB partitions (logical drives C and D). For the XCOPY from Winchester to Magneto-Optical test, we created a 115MB file system on drive D. (This system is identical to the one used in the article "QIC 150 Tape Drives: The Rising Star for Backup," *PC Magazine*, October 16, 1990.) All the magneto-optical drives used disks formatted with 512-byte sectors.

	DOS File Access (Small Records) Elapsed Time (seconds)	DOS File Access (Large Records) Elapsed Time (seconds)	DOS Disk Access Average Sector Access (milliseconds)	XCOPY from Winchester to Magneto-Optical Elapsed Time (hours:minutes:seconds)	XCOPY from Magneto-Optical to Winchester Elapsed Time (hours:minutes:seconds)
SST Storage Stak II	341.72	27.92	108.80	01:00:44	00:19:20
Xyxis XY 600RW	279.84	26.87	88.74	00:57:42	00:16:42
Consan RS600/N	277.89	27.41	89.07	00:57:45	00:18:23
DynaTek R0S600	274.59	24.46	88.35	01:11:31	00:17:03
Relax Optical 600 Plus	261.08	25.14	93.33	00:56:14	00:16:47
SD LaserStor Erasable Optical 650 MB	229.37	21.42	62.94	00:48:23	00:15:48
Procom MEOD650/E	213.94	18.65	73.07	00:39:07	00:17:10
APT Odessa ROS-3250EIS	199.92	21.20	59.08	00:53:04	00:14:59
* Pinnacle REO-650	195.59	17.67	68.04	00:35:20	00:14:05
Optima Concorde 600MO	188.32	17.32	62.75	00:35:17	00:14:33
Tecmar LaserVault	187.30	17.35	60.35	00:35:36	00:15:21
MicroNet SB-SMO/DOS	185.05	17.89	60.77	00:36:06	00:15:26
ASC MO-SS	164.45	15.55	41.19	00:27:25	00:16:44
FWB HammerDisk600S	157.63	16.24	57.66	00:34:56	00:14:25
OCEAN Tidalwave 650	157.30	17.38	58.77	00:35:16	00:16:38
Peripheral Infinity Optical	156.55	17.14	58.42	00:34:58	00:15:51
N/Hance W6501	101.29	12.96	N/A	00:19:18	00:32:43

* The Pinnacle REO-650 could not run the XCOPY tests with DOS 4.0's SHARE utility installed.

N/A—Not applicable: The N/Hance W6501 proved incompatible with our DOS Disk Access test.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

The DOS Disk Access benchmark test uses DOS interrupt 25h to directly read 1,000 random sectors. This test, which should work with any device that DOS recognizes as a disk, reports in milliseconds the average access time per sector.

The **XCOPY from Winchester to Magneto-Optical** benchmark test, which uses the XCOPY command with the /S switch, times the number of hours, minutes, and seconds for a hard disk to copy a 115MB file system to a formatted blank MO. This procedure can be used when archiving data from the hard disk to the MO.

The **XCOPY from Magneto-Optical to Winchester** benchmark test, which uses the XCOPY command with the /S switch, times the number of hours, minutes, and seconds for the MO to copy a 115MB file system to an empty hard disk. This procedure can be used when retrieving data from the MO to the hard disk.

MULTIFUNCTION DRIVES: The Best of Both Worlds

Combining write-once security with rewritable diversity—and costing little more than an MO drive—these new multifunction drives may just worm their way into your heart.

by M. David Stone

Snapping at the heels of the rewritable optical drive is the multifunction drive. A multifunction drive is a single unit that can function as either a WORM or rewritable drive, depending only on which kind of disk you use. At first glance, such a product may not seem noteworthy, but it's a strong contender for the future of optical drives.

Since multifunction drive prices are only a little higher than those of rewritable-only drives—$4,895 for Sony's multifunction E511, for example, compared with $4,650 for Sony's rewritable E501, and about $2,500 to $4,000 for a typical WORM unit—it is reasonable to buy a multifunction drive even if you're not sure you need both capabilities.

There are currently three camps of multifunction drive manufacturers. The first, led by Hewlett-Packard and Sony, uses magneto-optical disks for WORM and rewritable functions. The second is led by Pioneer and uses dye polymer disks for WORM and a different MO disk format for rewritable functions. The third, led by Panasonic, uses phase change disks for both the WORM and rewritable functions.

HP'S AND SONY'S MULTIFUNCTION

Hewlett-Packard's and Sony's approach wasn't ready in time to test for this overview, but it should be by the time this story is published. According to HP and Sony, it follows the already established ISO and ANSI standards for rewritable disks, extending those standards to WORM applications. The drives work the same as single-function MO drives, but when in WORM mode, the multifunction drive simply refuses to overwrite any information.

The key to this approach is to mold special identifier codes into write-once disks during production. The multifunction drive recognizes the codes and decides how to treat the disk—as write-once or rewritable. But if you put the specially-coded WORM disk in a single-function drive, the drive will object to the special codes, issue an error message, and refuse to read to or write from it.

PIONEER'S ALTERNATE MO DRIVE

Pioneer's approach to multifunctionality is being marketed by Pioneer itself (though Pioneer was unable to get a unit to us in time for review), Laser Magnetic Storage International (the $3,700 LMSI LD520-602), and Ten X Technology (the $5,995 Ten X OptiXchange). The Pioneer drive mechanism uses dye polymer WORM disks and magneto-optical rewritable disks. (In addition, the LMSI version can use ANSI standard format B ablative WORM media.) Note, however, that the MO disks are not compatible with the ANSI standard continuous composite servo (or CCS) MO disks. Rather, Pioneer uses an alternate ISO format called sampled servo (SS).

> Phase change drives are the first rewritables to offer one-pass writing.

Pioneer claims that the SS format is technically superior to CCS, allowing greater hard disk data density and lighter drive heads. All this should translate into greater disk capacity and faster performance. However, on our tests with rewritable media, the current crop of drives performed comparably to CCS MO drives.

Both the LMSI and Ten X packages produced results on our tests that were well within the range for CCS drives. On our XCOPY tests, when copying about 115MB of data to and from the drives, both packages were slower than many CCS drives (well over 40 minutes to copy the files from the hard disk and about 18 minutes to copy them back). Interestingly, the LMSI unit with an 8-bit Corel board was faster than the Ten X with a 16-bit Adaptec board.

GOING THROUGH PHASES

The third choice for multifunction drives uses phase change media for both WORM and rewritable disks. (For a discussion of phase change technology, see the sidebar "Seeking a Faster Drive: Up-and-coming Erasable Optical Technologies.") These phase change drives are available in packages from Panasonic and from Reflection Systems, both of which use a Matsushita drive mechanism. Corel Systems expects to have a package by the time this story is published, one which also uses the Matsushita drive mechanism.

The phase change drives are the first commercial rewritable optical drives that offer a one-pass write capability with a promise of faster write times. Indeed, on our XCOPY tests, when copying to the optical drive, both packages scored far better than most of the MO drives we tested (about 28 minutes to copy 115MB of files from the hard disk). Only the N/Hance and Advanced Storage Concepts entries were able to match or exceed these scores. In short, phase change drives on average did better than MO drives, but there are exceptions.

The two phase change packages, however, were significantly different when copying back to the hard disk. The Reflection RF-7010 package managed only a lackluster showing (17 minutes, 40 seconds), while the Panasonic came in with the fastest time

we measured (13 minutes, 4 seconds). This speed difference illustrates the importance of picking an optical drive by its overall package, which includes a SCSI controller and software. ■

LMSI LD520-602
Laser Magnetic Storage International Co., 4425 ArrowsWest Dr., Colorado Springs, CO 80907-3489; 719-593-7900.
List Price: With interface kit and rewritable cartridge, $3,700; additional media, $125 (WORM), $250 (MO). **Requires:** 62K of RAM or 3K of RAM with EMS installed, DOS 3.0 or later.
CIRCLE 621 ON READER SERVICE CARD

Panasonic LF-7010
Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000.
List Price: With interface kit and single-sided rewritable cartridge, $4,490; additional media, $149 (WORM), $125 (single-sided rewritable cartridge), $245 (double-sided rewritable cartridge).
Requires: 32K of RAM, DOS 3.31 or later.
CIRCLE 622 ON READER SERVICE CARD

Reflection RF-7010
Reflection Systems Inc., 99 W. Tasman Dr., San Jose, CA 95134; 800-445-9400, 408-432-0943.
List Price: With interface kit and rewritable cartridge, $4,740; additional media, $250 (rewritable cartridge), $149 (WORM). **Requires:** 50K of RAM or 3K of RAM with EMS installed, DOS 3.0 or later.
CIRCLE 623 ON READER SERVICE CARD

Ten X OptiXchange
Ten X Technology Inc., 4807 Spicewood Springs Rd., Bldg. 3, #3200, Austin, TX 78759; 800-922-9050, 512-346-8360.
List Price: With interface kit and cartridges (rewritable and WORM), MO and WORM, $5,995; additional media, $145 (WORM), $250 (MO).
Requires: 640K of RAM, DOS 3.31 or later.
CIRCLE 624 ON READER SERVICE CARD

stallation program that failed to properly copy all the necessary files to the disk as per the documentation, but also by a host adapter board that came configured to run a floppy disk drive. (Most people won't want to install the RS600/N or any MO drive as their primary device.) Consan says it is aiming this product at the VAR market rather than the end user and expects that its customers will have enough technical experience to handle any installation problems. The documentation provided enough rough reference to sort through these complexities, but if you have never tangled with such inconsistencies before, you may want to avoid the RS600/N.

The reward for your efforts during setup is not particularly great. Both the Ricoh drive's DOS File Access times proved among the slowest of all the drives tested. It also lagged in backup simulation, but strangely enough it did reasonably well in restoration.

The best part of the RS600/N is its price. The power and compatibilities of the Procomp host adapter have intriguing possibilities, but Consan has to swat the bugs in its installation procedure, streamline its driver, and place greater emphasis on the end user before the RS600/N becomes a real contender.

DYNATEK AUTOMATION SYSTEMS INC.

DynaTek ROS600

by M. David Stone

The $3,245 DynaTek ROS600 from DynaTek Automation Systems is a kind of budget workhorse. The least expensive drive tested, the DynaTek is based on a Ricoh drive mechanism providing a 66.7-millisecond average access time and is able to handle 1,024-byte-sector disks. But due to its mediocre performance, the DynaTek ROS600 proves to be merely a satisfactory but not exceptional choice.

The DynaTek subsystem is one of a family of packages for both ISA and MCA buses, at prices ranging from $3,245 to $3,695. The packages, which differ primarily in adapter card and driver software, are available for DOS, OS/2, Unix, and Novell operating systems, and with either ISA or MCA interface cards. (Each operating system requires its own adapter card.) There is also a Macintosh version for $3,150. However, none of these formats allow data exchange with any of the others.

The unit is identical for all packages and includes a power supply, a cooling fan, a SCSI ID selector, and a SCSI daisy chain port, along with the Ricoh drive mechanism. The interface card and software are both from Applied Programming Technologies, and the software includes a background formatting utility as well as a module for backing up data to the magneto-optical drive.

Installing the DynaTek is largely frustration free, with the credit going in equal measure to the installation utilities and the step-by-step instruction manual. To install the hardware, you plug the APT adapter card into any free slot, plug a cable between the card and the drive, and then plug in a power cord. The adapter card has a 16-bit extension, but because it only uses the extension for extended interrupts, the card will work in either an 8- or 16-bit slot. You will also find DIP switches and jumpers for setting IRQ and addresses, but in most cases you can leave these set to the factory defaults.

The software is even easier to install, though more time consuming. All you have to do is run the formatting and installation utility and work your way through the choices. The utility will install the 16K driver on your hard disk and automatically modify your CONFIG.SYS file. Other menu choices let you low-level format the MO disk and partition it up to a maximum partition size of 306MB.

Once installed, the DynaTek drive works as promised, though not with dizzying speed. It produced slower than average times on PC Magazine Labs' DOS Disk and DOS File Access tests and finished abysmally on the XCOPY from

FACT FILE

DynaTek ROS600
DynaTek Automation Systems Inc., 15 Tangiers Rd., Toronto, Ontario, Canada M3J-2B1; 416-636-3000.
List Price: With interface kit and cartridge, $3,245; additional media, $225.
Requires: DOS 2.x or later, 256K RAM.
In Short: The DynaTek ROS600, a Ricoh-based system, carries the lowest price tag here, and the included menu-driven utilities make it a breeze to set up. But these pluses are damaged a little by its below-average performance.
CIRCLE 607 ON READER SERVICE CARD

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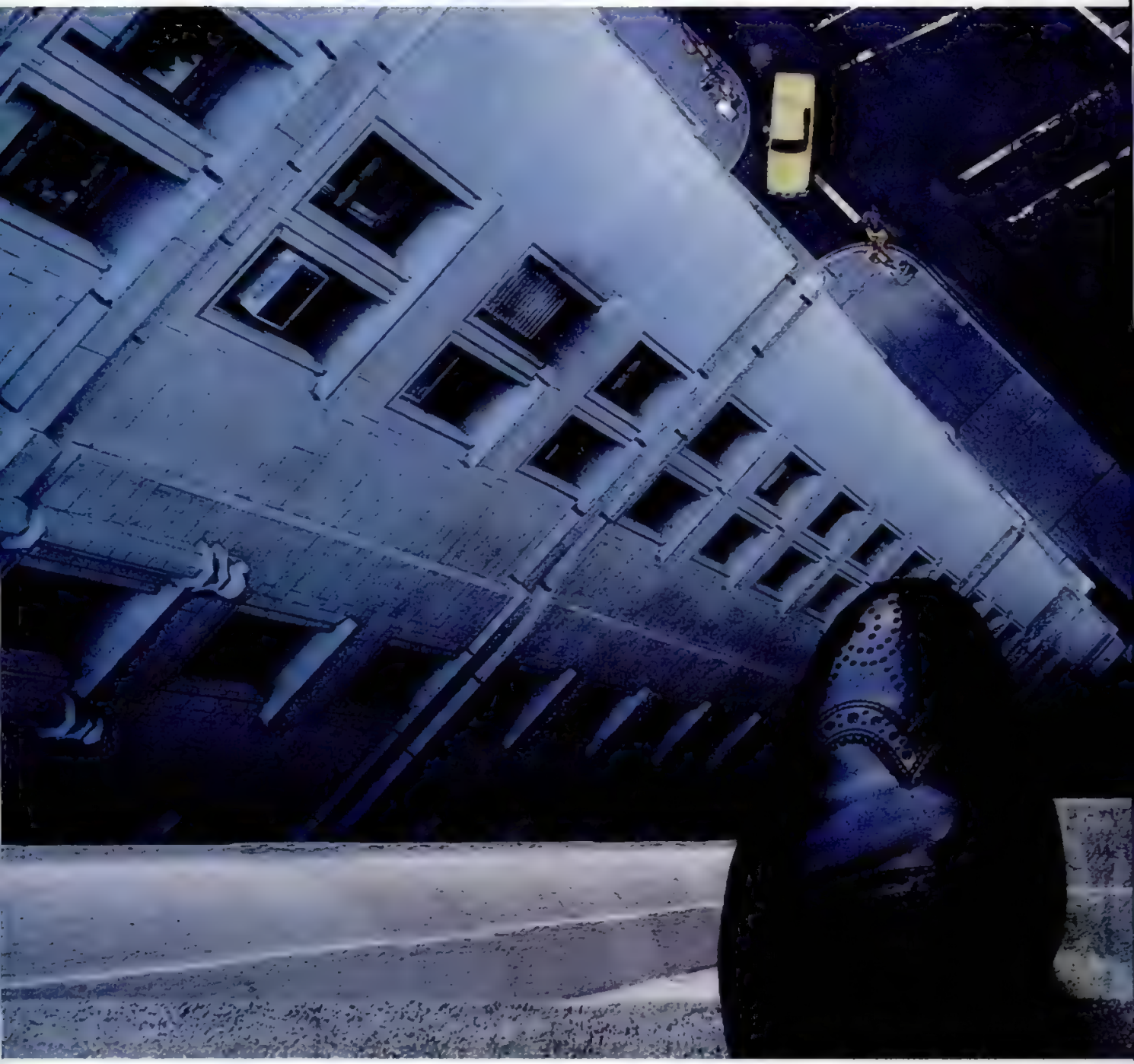

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CIRCLE 223 ON READER SERVICE CARD

Winchester to Magneto-Optical test. However, the DynaTek's Winchester-to-MO speed was acceptable. Applied Programming Technologies claimed the poor performance is restricted to the 512-byte-sector disks, explaining that the package is optimized for 1,024-byte sectors; it supports a disk with 512-byte sectors by simulating one with 1,024-byte-sectors. The result is extra overhead with 512-byte-sector disks. On the PC Labs tests, however, the subsystem did not work significantly faster with 1,024-byte-sector disks.

All told, the DynaTek ROS600 is an acceptable if less than exciting selection. The drive's formatting speed and its backup module are important strengths, and its slow performance is counterbalanced by a low price. The DynaTek ROS600 gives you what you pay for—no more, no less.

FWB INC.

FWB HammerDisk600S

by Winn L. Rosch

Easy installation and tight integration under DOS mark the FWB HammerDisk600S as a top choice for no-hassle magneto-optical storage. The $6,085 subsystem (the second-most expensive in our roundup) must be bought piecemeal: $5,495 for the Sony drive with its 107.5-milliscecond average access time, $295 for the host adapter, and $295 for a cartridge add up to a grand total of $6,085. The Hammer-Disk600S rates as close to plug-and-play as MO subsystems get, yet it has the hustle to keep up with other drives in its class.

FWB aims primarily at the Macintosh market and includes a legion of Macintosh software with the HammerDisk600S. For PC installation, FWB offers an Always Technology (Westlake Village, California; 818-597-1400) IN-2000 host adapter, based on Xilinx chips, which the company sets up at the factory to simply slide into an expansion slot and work. Disks written on a DOS-based HammerDisk600S can be read by a Macintosh and vice versa. Versions are also available for OS/2, Unix, and Novell.

All of the software that is necessary for bringing the subsystem to life is stored in on-board ROM. The only potential adjustment is a DIP switch on the half-length 16-bit host adapter, which allows the selection of an alternate BIOS location for non-standard PCs (those with drive BIOS's located somewhere other than at C8000 (Hex)).

The 4.75- by 9.5- by 9.75-inch drive connects to the 25-pin D-shell jack on the host adapter through the 20-inch cable supplied by FWB. The HammerDisk600S offers two 50-pin SCSI jacks and terminates externally. A termination SCSI plug is also supplied with the subsystem.

After the physical installation, which amounts to nothing more than plugging in the cables and terminator, the host computer will boot up with only a new sign-on message hinting at its magneto-optical enhancement.

As with standard DOS disks, cartridges need to be prepared for use by the FDISK and FORMAT utilities. Formatting a 512-byte-sector cartridge took a relatively quick 10 minutes. The package does not support 1,024-byte sectors.

After formatting, you can use the HammerDisk600S for primary storage. It will even boot the host system if you use the /S option to transfer the necessary DOS files to it. The host adapter can also serve as the host system's floppy disk drive controller.

In testing under DOS, the HammerDisk600S shone as one of the quicker units among those we tested. Its DOS File Access and Disk Access times are in the top five, while its XCOPY results were also quite good.

The stiff price of the HammerDisk600S is its only discouraging feature, and with its laudable performance, the FWB HammerDisk600S is a storage subsystem for anyone who doesn't mind paying a bit more to minimize hassles and maximize hustle.

FACT FILE
EDITORS' CHOICE

FWB HammerDisk600S
FWB Inc., 2040 Polk St., #215, San Francisco, CA 94109; 415-474-8055.
List Price: With interface kit and cartridge, $6,085; additional media, $295.
Requires: DOS 3.3 or later, 640K RAM.
In Short: Though not cheap, the Sony-based HammerDisk600S delivers solid performance and a trouble-free match with DOS, OS/2, Novell, and Xenix.

CIRCLE 608 ON READER SERVICE CARD

MICRONET TECHNOLOGY INC.

MicroNet SB-SMO/DOS

by Henry Fersko-Weiss

MicroNet has hooked a 107.5-millisecond (average access time) Sony drive mechanism to an Intel 8188 microprocessor–equipped controller card and included a special low-level format program with its magneto-optical subsystem, the MicroNet SB-SMO/DOS. The result is an expensive $5,479 with midrange scores on our performance tests, but it can also multitask with other SCSI devices without degrading performance.

The way MicroNet implements the subsystem's 8188 microprocessor chip makes it a unique feature among the packages tested, all of which can speak SCSI. Most of these subsystems do not use a microprocessor, and the MicroNet SB-SMO/DOS's chip, according to the company, gives the subsystem more intelligence. MicroNet claims this feature allows the bus-mastering controller to do true multitasking (up to 255 tasks at once) when more than one SCSI device is connected. The chip is also supposed to optimize the CPU utilization. MicroNet claims that in day-to-day operation with more than one device connected, the microprocessor and *SCSI Prep* low-level formatting software improve performance by up to 20 percent.

The SB-SMO/DOS only accepts 512-byte-sector Sony cartridges. If the cartridge you are using comes from MicroNet, it will already be low-level formatted using the *SCSI Prep* program. If not, you should use the program to format it in order to optimize speed and gain an extra-large per-side capacity of 293MB. Running *SCSI Prep* takes about 25 minutes.

FACT FILE

MicroNet SB-SMO/DOS
MicroNet Technology Inc., 20 Mason, Irvine, CA 92718; 714-837-6033.
List Price: With interface kit and cartridge, $5,479; additional media, $279.
Requires: DOS 2.x or later, 512K RAM.
In Short: The high-priced Sony-based MicroNet SB-SMO/DOS comes with well-designed software and a microprocessor optimized for SCSI multitasking, but it delivers unspectacular performance.

CIRCLE 609 ON READER SERVICE CARD

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CIRCLE 144 ON READER SERVICE CARD

The SB-SMO/DOS currently comes only as an external drive measuring 6.6 by 7.6 by 12 inches, but by the end of April, MicroNet will offer an internal version. The $5,479 ISA version we tested includes a controller board with an NCR chip set, cables, drivers, the *SCSI Prep* program, and *AFDISK*, a partitioning and formatting utility from Adaptec (Milpitas, California; 408-945-8600). The drive is also available in EISA, MCA, or Macintosh versions, and a set of drivers for all the supported networks costs an additional $110.

Installing the drive is a snap. All you need to do is put the board in your computer and then attach the cable and power cord. If you have to change IRQ, DMA channel or other addresses, you will need to use two sets of DIP switches. Jumpers let you control the DMA speed as well as enable or disable the floppy disk drive controller.

You don't have to use the DOS drivers or the AFDISK utility to run the subsystem. However, the drivers will let you perform other functions. For example, you can lock the device through software so a cartridge cannot be removed. This is a nice safety feature if more than one person is using the drive.

> What N/Hance does differently is employ a software package, *WOFS-DOS*, which provides cross-platform portability.

Hopefully, these extra functions will be enough to satisfy you. Even with the drivers installed for testing, the unit still showed only slightly better than average results across the board. Of the drives tested, the SB-SMO/DOS placed either sixth or seventh on all the tests except the DOS File Access (Large Records) and XCOPY from Winchester to Magneto-Optical tests. On both of these it placed ninth—a satisfactory showing, but certainly not exemplary.

MicroNet offers a solid warranty and technical support. If anything should go wrong with the subsystem, there are separate support staffs for PCs and compatibles, Sun workstations, and the Macintosh. The warranty on the drive is for two years on parts and one year on labor.

The MicroNet SB-SMO/DOS is an average magneto-optical subsystem with decent performance results and good technological support. The controller's claimed ability to do multitasking with multiple SCSI devices would definitely make it an excellent choice for network environments.

N/HANCE SYSTEMS INC.

N/Hance W6501

by John R. Quain

By moving away from conventional wisdom, the N/Hance W6501 delivered some of the fastest performance results on our benchmark tests—but made some DOS trade-offs to get there.

Complete with software, cables, adapter card, and the 107.5-millisecond (average access time) Sony drive mechanism, the W6501 lists for a slightly pricey $5,450 (the internal drive option is $400 less). The subsystem is controlled by a 16-bit Adaptec (Milpitas, California; 408-945-8600) SCSI host adapter card (an optional MCA adapter costs an additional $200). The W6501 allows you to boot from a magneto-optical disk, and unlike most of the magneto-optical units in this roundup, it can support both 512-byte and 1,024-byte sectors.

What N/Hance does differently from many of the other vendors represented here is employ a sophisticated software package, *WOFS-DOS*, designed to optimize the particular aspects of magneto-optical disk storage and provide cross-platform portability. The software allows you to move between Unix-based Sun SPARCstations and DOS environments with ease (the company has plans to support the Macintosh platform, but there is no release date as yet). The W6501 supports DOS 3.0 or later; Unix Sun, Version 4.1.1; Novell's *NetWare 286* and *NetWare 386;* as well as 3Com as a node. Unfortunately, DOS-only users may find the *WOFS-DOS* side effects worse than its benefits.

Currently, N/Hance's TSR device driver requires approximately 130K of conventional memory to access the magneto-optical drive as a DOS device—too steep a requirement for the subsystem to also handle the demands of today's applications. You cannot remap memory to accommodate the driver because it currently requires at least 110K of contiguous memory. Recently, however, N/Hance has been working to reduce the driver demands to 80K and break the software into modules for users who want to remap memory.

N/Hance's approach also creates significant advantages—and weaknesses—when it comes to storage performance. For the DOS File Access (Small Records) test, the W6501 posted the fastest times—twice as fast as the average. It was also the best performer on the DOS File Access (Large Records) test, though the differences between it and the other SCSI subsystems were not as dramatic.

In another suite of tests, the N/Hance W6501 raised eyebrows for different reasons. MO subsystems must make two passes over a disk to write data to it and only one pass to read it back. Consequently, we expected much slower write times than read times. However, on our XCOPY tests, the W6501 copied data from the hard disk to the MO in record time—first again among the drives tested. In copying from the MO to the Winchester, however, data flow slowed substantially. In fact, the W6501 turned in the slowest time of the lot on this test. (The unit yielded similar results when using 1,024-byte-sector disks.)

For DOS users, the W6501 had an even more significant drawback. Out of 17 machines tested, the N/Hance W6501 was the only drive that could not perform PC Magazine Labs' DOS File Access tests. This is due to the *WOFS-DOS* parallel-

FACT FILE

N/Hance W6501
N/Hance Systems Inc., 908R Providence Hwy., Dedham, MA 02026; 617-461-1970.
List Price: With interface kit and cartridge, $5,450; additional media, $250.
Requires: DOS 3.0 or later, 640K RAM.
In Short: The Sony-based N/Hance W6501 came with a powerful driver that made it one of the fastest scorers on our most important tests. But the same driver included DOS incompatibilites that could spell trouble for the unprepared user.

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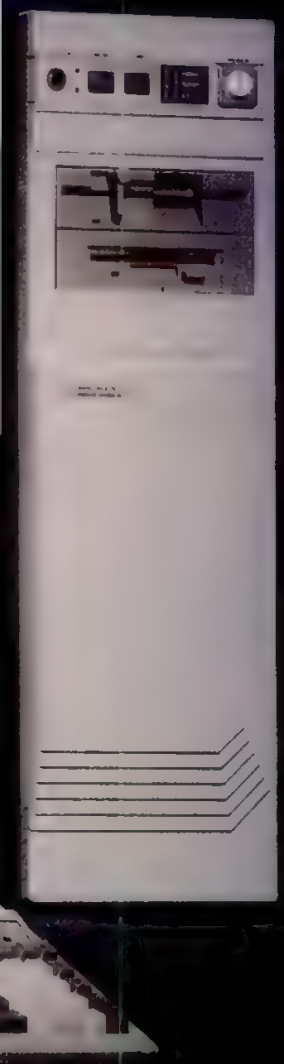

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*PC Magazine, September 25, 1990

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file system, which does not support DOS interrupt 25h. (Interrupt 25h is used by some programs to get device-parameter information—such as sector size, number of sectors, and number of tracks—from any device DOS recognizes as a disk.) This means that users may encounter commercial programs that will not run on the W6501.

Given the strong showing this subsystem made, it may seem as if no single compromise is very significant. Taken together, however, they indicate potential compatibility woes for DOS users. Along with its upper-end price, the N/Hance W6501 delivers excellent speed, but be sure to weigh that performance advantage against the incompatibility hazards before you buy.

OCEAN MICROSYSTEMS INC.

OCEAN Tidalwave 650

by John R. Quain

If you're using DOS 4.01, you will be content with the straightforward operation of the OCEAN Tidalwave 650. Though the Tidalwave's performance wasn't exactly sparkling, it did float above the watermark with better-than-average times on all the PC Magazine Labs benchmark tests.

Furthermore, the taupe and gray Tidalwave is a reasonably priced subsystem. For a complete package, which includes the 107.5-millisecond (average access time) Sony drive mechanism, an 8-bit SCSI adapter card from Future Domain, and one formatted optical disk, the Tidalwave is competitively priced at $4,495. This package includes software for installation, formatting, and partitioning, but will only accept 512-byte-sector disks.

The software driver OCEAN has developed requires a meager 7.5K of conventional memory and treats the magneto-optical subsystem like a floppy disk drive so that it will automatically recognize different cartridges or sides. One restriction is that if you're still using DOS 3.3, you cannot format the magneto-optical disk as a single 282MB partition. If you have DOS 4.01, you can create such partitions, and the simplicity of the driver and its low overhead means few compatibility issues with DOS applications. For data backup, the Tidalwave will work with *The Norton Utilities, PC Tools,* and *Fastback Plus*. OCEAN also supports SCO Unix V; Novell *Advanced NetWare 286,* Version 2.15; and Novell *NetWare 386,* Version 3.0 or higher.

The menu-driven software installation is straightforward, but it doesn't allow the user to assign a letter to the drive. On our test-bed system (a Compaq Deskpro 386/25 equipped with an ESDI controller), the Tidalwave failed to recognize the logical partition on our hard disk and proceeded to install itself as drive D—initially preventing us from running PC Labs' XCOPY test.

We brought the problem to the attention of OCEAN's technical staff. They discovered a conflict with Compaq's BIOS, worked out a fix, and sent us a new version of the driver in time to complete our testing. The Tidalwave finished with above average marks. Though the Tidalwave didn't blow through PC Labs' tests like a tsunami, it did perform well, delivering read/write times that kept it firmly planted in the top half of the tested MO subsystems. It came in fourth on the DOS Disk Access test, and its times for both the DOS File Access tests were comfortably above average.

OCEAN offers several storage devices, including Bernoulli Box systems. The company was recently acquired by Nakamichi, which has introduced a 3.5-inch magneto-optical drive based on preliminary ANSI and ISO standards. (Pinnacle has released a system built around the new Nakamichi drive, and OCEAN is expected to follow suit.) OCEAN backs up its products with a toll-free technical support phone line and a one-year parts-and-labor warranty. From all indications, OCEAN's commitment to the technology seems resolute. The OCEAN Tidalwave 650 is a strong competitor in largely uncharted storage waters.

FACT FILE

OCEAN Tidalwave 650
OCEAN Microsystems Inc., 246 E. Hacienda Ave., Campbell, CA 95008; 800-262-3261, 408-374-8300.
List Price: With interface kit and cartridge, $4,495; additional media, $249.
Requires: DOS 3.3 or later, 512K RAM.
In Short: The Sony-based Tidalwave 650 provides solid performance, a reasonable price, and a small though somewhat quirky proprietary driver.

CIRCLE 611 ON READER SERVICE CARD

OPTIMA TECHNOLOGY CORP.

Optima Concorde 600MO

by Henry Fersko-Weiss

Built around a 107.5-millisecond (average access time) Sony drive mechanism, the slightly expensive Optima Concorde 600MO provides little that's unusual in its 512-byte-sector-only package. It supports a wide range of computer platforms and operating systems but does not set any new speed records.

The Concorde's base unit sells for $5,590 and includes one cartridge (additional cartridges cost $395). It is compatible with ISA or EISA computers, PS/2s, and the Macintosh, but each of them requires the proper application kit. The ISA/EISA kit costs $595 and includes a SCSI controller, cables, drivers for DOS, and *OFDISK*, a formatting and partitioning utility made for Optima by Adaptec (Milpitas, California; 408-945-8600). The MCA kit also costs $595; the Macintosh kit, with more extensive software and a cable, costs $99. Driver sets for Novell's *NetWare 286;* Novell's *NetWare 386;* or OS/2, Versions 1.1 and 1.3, cost $99 each.

Installing the Concorde is simple. In most cases, you merely put the board in your computer, connect the cable, and use DOS FDISK and FORMAT commands to prepare the Sony cartridge. If you have to change the IRQ, DMA channel, BIOS, or I/O port addresses, there are a series of jumpers on the board and clear directions in the manual. You don't have to use the *OFDISK* or DOS drivers, but they are required if you intend to use more than one cartridge.

Although the drive is external, Optima has given you a way to make the footprint flexible. The Concorde comes with a 4.6-

FACT FILE

Optima Concorde 600MO
Optima Technology Corp., 17526 Von Karman, Irvine, CA 92714; 714-476-0515.
List Price: With interface kit and cartridge, $5,590; additional media, $395.
Requires: DOS 3.2 or later, 512K RAM.
In Short: The Concorde 600MO, a Sony-based system, combines middling performance with clever exterior design and solid service—for a price tag at the upper end of the scale.

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INTEGRATED INFORMATION

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CIRCLE 192 ON READER SERVICE CARD

by 11.4- by 10.2-inch horizontal orientation, but you can easily pry off its hard plastic feet and snap them back on so the drive sits vertically—great for cramped desk space. Another design feature is the auxiliary power connector on the back of the subsystem. Optima sells an external power supply for $99 that can connect to the drive and keep you running in case the internal power supply dies. The internal power supply is an independent module held in place by a clip, so it's easy to change.

The Concorde's clever design did not, however, spill over onto its performance. It ran almost every test smack in the middle of the group. We tested the drive with and without the included drivers and found virtually no difference in performance. However, none of its scores were abysmal, and the Concorde did place second on the XCOPY from Magneto-Optical to Winchester test.

If anything goes wrong with the drive in the first 30 days, Optima will send you a replacement overnight. The normal one-year warranty on parts and labor is handled by Optima directly and is backed up by free telephone, fax, and BBS technical support. Optima also offers a three-year warranty plan for 15 percent of the original purchase price. This plan entitles you to overnight replacement over the life of the warranty.

When you add all this up, you will find the Optima Concorde 600MO is a drive with middle-of-the-pack performance, clever exterior design, the usual support, and a slightly weighty price tag.

PERIPHERAL LAND INC.

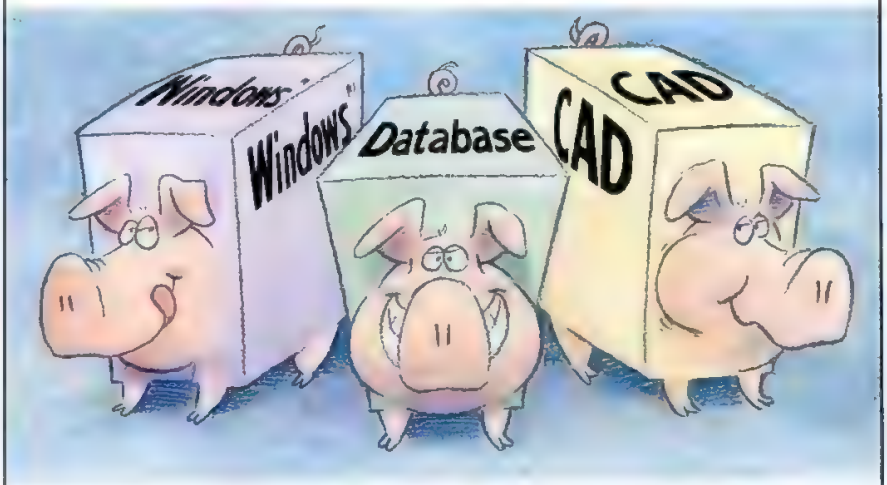
PLI Peripheral Infinity Optical

by Kellyn S. Betts

If Peripheral Land were in Rome, it would be quickly driven out of town for failing to adhere to local customs. The company offers a fast, fairly-priced but Macintosh-centric magneto-optical subsystem that fails to fully embrace the PC market for which the 107.5-ms. (average access time) Sony-based Infinity Optical is intended.

Though the $4,799 Infinity Optical has been actively marketed to PC users for a year, a PC user opening the box may think

Handle your memory hogs while preventing system lockups.



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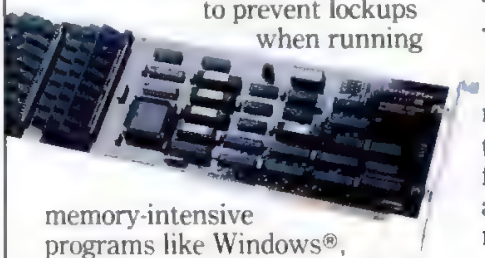

+ On-board Error Detection and Correction prevents system lockups because it *corrects* bit errors during memory access.
+ Compatible with DOS, OS/2, UNIX/XENIX, Windows 3.0.
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+ Compatible with the LIM EMS 4.0 expanded memory standard by using included software.
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CIRCLE 175 ON READER SERVICE CARD

he or she has been accidentally sent the wrong product. Everything that comes with the drive is labeled "For the Apple Macintosh." You have to open up the smaller box containing the 8-bit SCSI card to find a product designed for the PC.

The only things that show the Infinity Optical will even work on a PC are a couple of chapters in the manual and the PC driver and utility software with the PLI SCSI card. Plus, if you use a Macintosh as well as a PC, there is also plenty of usable Apple software, including some that translates files from Mac to DOS format.

Despite its alien orientation, the Infinity Optical is easy enough to set up and use. The utility software includes installation and test programs that work admirably. While disks must undergo a low-level format before being used for the first time—a task requiring over 25 minutes to accomplish—the PLFORMAT utility simplifies the process of creating a DOS-recognizable drive as well as partitioning it. Along these lines, the package does not support 1,024-byte-sector disks.

These utilities proved quite useful. For example, the drive was among the speedier drives in this roundup. But these tests used DOS as a vehicle for backups; the time to write from a Winchester disk to the MO can be reduced by nearly two-thirds by using the PLBACKUP utility, which performs file-by-file as well as image backups and restorations. Other utility software includes a program to create one large virtual drive from two smaller SCSI drives and the ability to implement RAM caching for any SCSI device.

The Infinity Optical's packaging, though annoying, is of little importance. The drive's combination of reasonable price, high-performance, and an adequate selection of software still makes it a good buy. Certainly it's a great product to consider if you have Macs and PCs.

Despite its Macintosh orientation, PLI's installation utility makes it easy to set up and use.

FACT FILE

PLI Peripheral Infinity Optical
Peripheral Land Inc., 47421 Bayside Pkwy., Fremont, CA 94538; 800-288-8754, 415-657-2211.
List Price: With interface kit, $4,799; additional media, $299.
Requires: DOS 3.3 or later, 512K RAM.
In Short: The Sony-based midrange-priced Peripheral Infinity Optical is aimed primarily at the Macintosh market, but with the proper options, it can deliver solid PC performance.

CIRCLE 613 ON READER SERVICE CARD

PINNACLE MICRO INC.

Pinnacle REO-650

by John R. Quain

The difference between good news and bad news depends on your point of view. In this case, the good news is that Pinnacle

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Micro's REO-650 placed first on PC Magazine Labs' XCOPY from Magneto-Optical to Winchester test. The bad news is that it was the only subsystem in the roundup that, due to compatibility problems, had to be tested without DOS 4.01's SHARE installed.

In addition to this incompatibility, the REO-650's price isn't very enticing: $5,239 for the complete drive subsystem, including a 16-bit Western Digital (Irvine, California; 714-932-5000) 7000 SCSI host adapter. The REO-650 uses 512-byte-sector disks—it does not support 1,024-byte disks. Built around a 107.5-ms. Sony drive mechanism, the package includes installation and utility software and a driver that requires a minimum of 35K of conventional memory.

The REO-650's performance results were about average. Although turning in above-average results for the DOS Disk Access and small-record DOS File Access tests, it still fell below the median for the rest of the tests. With the advantage of the Western Digital bus-mastering adapter, it did better on the large-record test and placed in the top half of the group. All the subsystems in this roundup—except the REO-650—used DOS 4.0's SHARE to perform these tests.

> The Pinnacle REO-650's software menus give clear instructions that simplify installation.

When we performed the XCOPY test back to the hard disk, however, the PC hung. It could only be returned to normal operation by powering down. We discovered that the REO-650 and Western Digital SCSI controller combination would not work properly with DOS 4.0's SHARE installed. (Inquiries to Pinnacle Micro failed to resolve the incompatibility.) SHARE allows older DOS applications to read and write to partitions larger than 32MB. (For an in-depth discussion of SHARE, see the "Tutor" column in PC Magazine's March 12, 1991, issue.) The REO-650's incompatibility with SHARE may pose a problem for users who rely on older programs constrained by DOS 3.3 and earlier.

Once we removed SHARE from our system, the REO-650 did not encounter any further difficulties. It yielded the fastest XCOPY to Winchester time in our group. However, the absence of SHARE in this test means this subsystem's performance cannot be accurately compared with that of the other subsystems in this roundup.

As for the rest of the REO-650 package, Pinnacle Micro provides one of the more complete manuals around. The software simplifies installation, and menus with clear instructions—including five frightening warning messages before you can perform a low-level format—help you with formatting and related tasks.

Users looking to easily move data from DOS platforms to Sun or other platforms will be disappointed. The REO-650 requires data-conversion software to perform such tasks, although it can work with either OS/2, Versions 1.1 and 1.2; Unix

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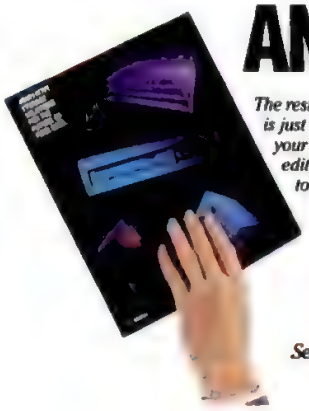

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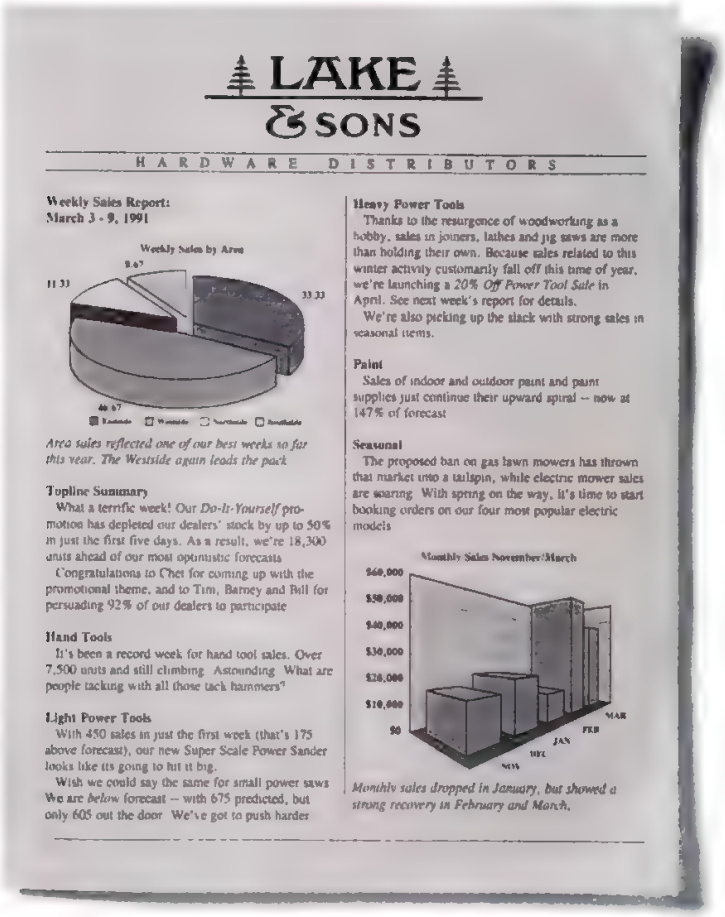

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Weekly Sales Report:
March 3 - 9, 1991

Weekly Sales by Area

Area sales reflected one of our best weeks so far this year. The Westside again leads the pack

Topline Summary

What a terrific week! Our *Do-It-Yourself* promotion has depleted our dealers' stock by up to 50% in just the first five days. As a result, we're 18,300 units ahead of our most optimistic forecasts.

Congratulations to Chet for coming up with the promotional theme, and to Tim, Barney and Bill for persuading 92% of our dealers to participate.

Hand Tools

It's been a record week for hand tool sales. Over 7,500 units and still climbing. Astounding. What are people tacking with all those tack hammers?

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With 450 sales in just the first week (that's 175 above forecast), our new Super Scale Power Sander looks like its going to hit it big.

Wish we could say the same for small power saws. We are *below* forecast -- with 675 predicted, but only 605 out the door. We've got to push harder.

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Thanks to the resurgence of woodworking as a hobby, sales in joiners, lathes and jig saws are more than holding their own. Because sales related to this winter activity customarily fall off this time of year, we're launching a *20% Off Power Tool Sale* in April. See next week's report for details.

We're also picking up the slack with strong sales in seasonal items.

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Sales of indoor and outdoor paint and paint supplies just continue their upward spiral -- now at 147% of forecast.

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The proposed ban on gas lawn mowers has thrown that market into a tailspin, while electric mower sales are soaring. With spring on the way, it's time to start booking orders on our four most popular electric models.

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(This impression courtesy of the Hewlett-Packard LaserJet III printer.)

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CIRCLE 103 ON READER SERVICE CARD

FACT FILE

Pinnacle REO-650
Pinnacle Micro Inc., 15265 Alton Pkwy., Irvine, CA 92718; 800-553-7070, 714-727-3300.
List Price: With interface kit, $5,239; additional media, $249.
Requires: DOS 3.2 or later, 512K RAM.
In Short: With average performance and a midrange price, the Sony-based Pinnacle REO-650's only extraordinary feature is an incompatibility with the DOS 4.0 SHARE utility.

CIRCLE 614 ON READER SERVICE CARD

(AT&T, Intel 13.2, Santa Cruz, Xenix, and SCO Unix); Novell *NetWare 286*, Version 2.1 or later; and Novell *NetWare 386*, Version 3.0.

Pinnacle Micro sells a full line of optical storage packages, the largest of which is capable of storing 36GB and costs $49,950. The company's coverage includes toll-free technical support and a one-year parts-and-labor warranty. If SHARE is not an important part of your environment, you shouldn't encounter any difficulties with this subsystem, and the REO-650's above-average performance and reasonable price means there are worse storage decisions you could make.

PROCOM TECHNOLOGY INC.

Procom MEOD650/E

by Bill O'Brien

Procom is making a lateral move from the Macintosh environment to the IBM PC. Its familiarity with optical disk and SCSI technology for the Macintosh has carried over to its new PC-oriented entry, the $5,294 Procom MEOD650/E. Based on a Sony drive mechanism with a 107.5-ms. average access time, this subsystem is a smooth performer.

Procom provides the Sony drive in a 6.5- by 7.5- by 12-inch housing that also contains its own power supply. The MEOD650/E uses standard 512-byte-sector cartridges only. Because SCSI is not the standard interface for PCs (as it is in the Macintosh world), Procom also provides its own CC-16 Enabler. The Enabler is a SCSI host adapter designed for a 16-bit ISA bus (an 8-bit CC-8 Enabler costs $189, an MCA version is already available for $349, and an EISA card is in the works).

The MEOD650/E's documentation is light, and the manual primarily addresses the various jumper settings required to set up the card correctly. The CC-16 Enabler has a built-in floppy disk drive controller, and the optical subsystem can be used as the primary boot device. Adding it as a secondary drive in most cases will only mean removing a jumper to disable the floppy disk drive controller. The installation software is menu-driven, straightforward, affects only on the Procom drive, and includes enough redundancy to prevent accidentally formatting cartridges or deleting partitions.

The MEOD650/E has a unique feature called DynaBoot, a dynamic reassignment of the boot drive from among any partition currently stored on the Procom's media. Certainly such an arrangement gives you a variety of operating systems to choose from. (Current choices are DOS; OS/2, Versions 1.2 and 1.3. Unix capability is on the way.) But there is also a secondary benefit for DOS users. With DynaBoot, you can set up separate boot partitions containing environment drivers (such as those for CD ROMs) or specialized TSRs, for example, that you don't work with every day. When you need them, just reboot from the partition containing them; in the meantime, they don't occupy system memory.

On the downside, the DynaBoot facility condemns you to boot from a drive that took by far the longest to copy files from the Winchester. (The MEOD650/E was a little faster when returning the files to the hard disk, but it was still far from speedy.) Program loads will uncover the most noticeable lags in the drive's transfer rate, but applications that maintain disk space as virtual memory also cause annoying delays. Of course, if you're adding the MEOD650/E to an existing SCSI system, you can always switch to your standard hard disk as the primary drive once you have completed the boot.

FACT FILE

Procom MEOD650/E
Procom Technology Inc., 200 McCormick, Costa Mesa, CA 92626; 714-549-9449.
List Price: With interface kit, $5,294; additional media, $295.
Requires: DOS 2.0 or later, 640K RAM.
In Short: Thanks to its DynoBoot utility, the Sony-based Procom MEOD650/E can be a handy addition to an existing SCSI system, but its price and performance are merely average.

CIRCLE 615 ON READER SERVICE CARD

If you're looking to add a magneto-optical drive to a SCSI system, Procom's DynaBoot magic and its SCSI savvy make the MEOD650/E a natural choice. But barring that circumstance, the pricing and performance of the MEOD650/E put it on merely equal footing with the competition on the market today.

> If you want to add a magneto-optical drive to a SCSI system, Procom's DynaBoot magic and SCSI savvy make the MEOD650/E a natural choice.

RELAX TECHNOLOGY INC.

Relax Optical 600 Plus

by John R. Quain

Simple and inexpensive describes the $3,377 Relax Optical 600 Plus. Unfortunately for this 66.7-ms. (average access time) Ricoh-based drive, so do tardy and limited.

The Optical 600 Plus arrived fully configured. Installation was a remarkably easy operation. The Optical 600 Plus comes with connecting cables, menu-driven installation software (with a no-frills backup utility), an 8-bit Trantor Systems (Fremont, California; 415-770-1400) SCSI adapter, and one 3M 512-byte-sector cartridge.

You can boot up your PC from the Optical 600 Plus. The only drawback here is that the Relax Optical 600 Plus supports only ISO 512-byte-sector disks, but at current prices, even on a dollar-per-megabyte basis you'll still come out ahead. You can partition the disks into four volumes ranging in size from 1MB to 280MB.

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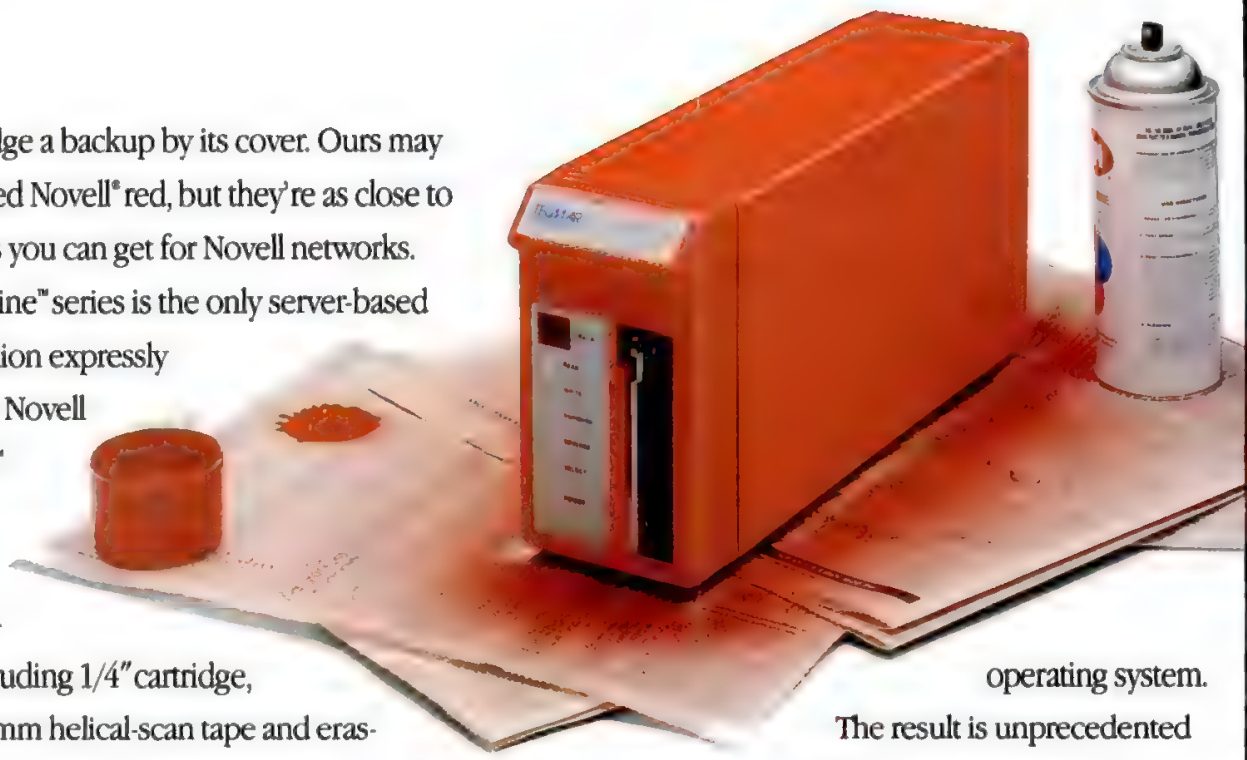

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Each ProLine drive also comes with Tecmar's ProServe™ software. ProServe's Value Added Process (VAP™) for NetWare 286 and NetWare Loadable Module (NLM™) for NetWare 386 run concurrently with other applications on the filer server. And ProServe is integrated into the network operating system. The result is unprecedented performance—up to 14.4 MB per minute.

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CIRCLE 384 ON READER SERVICE CARD

Technology generates, it's a shame to discover a fundamental weakness: performance. Of the tested subsystems, the Relax Optical 600 Plus yielded the second-slowest DOS Disk Access result, and its DOS File Access speeds were slightly slower than those of the average magneto-optical subsystem. It also lagged far behind on our XCOPY from Winchester to Magneto-Optical test, though it was a bit faster when restoring data to the Winchester and performed close to the median mark.

> The Optical 600 Plus's built-in surge and spike power controller accommodates three more components.

If you want cross-platform media, the Optical 600 Plus will not completely fulfill your needs in this area either. The subsystem does not let users automatically move data stored under one operating system to another, but the driver is compatible with DOS 3.0 and later as well as Novell *NetWare 286*, Versions 2.12 and 2.15. If you want Macintosh and Sun compatibility, you must buy the additional packages from Relax (an MCA version is available for the same price as the tested ISA). DOS-to-Macintosh and Macintosh-to-DOS conversion software is a $99 option.

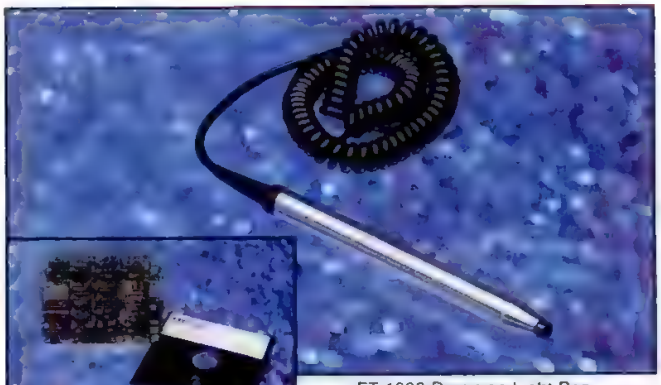
Relax Technology also sells surge and spike protectors (hence the Plus designa-

FACT FILE

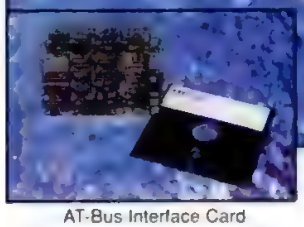
Relax Optical 600 Plus
Relax Technology Inc., 3101 Whipple Rd., Union City, CA 94587; 415-471-6112.
List Price: With interface kit, $3,377; additional media, $199.
Requires: DOS 3.0 or later, 640K RAM.
In Short: The Optical 600 Plus is based on the Ricoh mechanism. Inexpensive and simple to set up, it suffers from performance and cross-platform limitations.

CIRCLE 616 ON READER SERVICE CARD

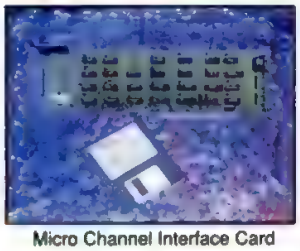
No More Mousin' Around



FT-1000 Precision Light Pen



AT-Bus Interface Card



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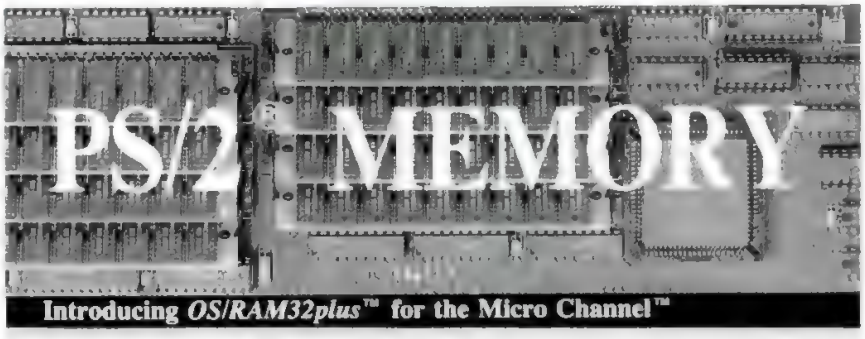
CIRCLE 524 ON READER SERVICE CARD



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CIRCLE 128 ON READER SERVICE CARD

tion). The subsystem's built-in surge and spike power controller can accommodate three additional components. The four power switches on the front of the Optical 600 Plus are marked "computer," "printer," "hard disk," and "master," but you can use the AC outlets for any peripheral.

The company provides one-year parts-and-labor coverage and over-the-phone technical support, although there is no 800 number. Ultimately, if you want straightforward turnkey storage, you should take the time to consider the Optical 600 Plus; but if you want speed and agility, search elsewhere.

SPECIALIZED SYSTEMS TECHNOLOGY

SST Storage Stak II

by Kellyn S. Betts

Specialized Systems Technology presented its magneto-optical drive as part of a sandwich design. Squeezed in between a 780MB hard disk and a 1.3GB 4-mm. DAT tape drive, the $4,422 Storage Stak II aptly illustrates how it received its name.

Since SCSI cards can address up to seven devices, the company attempts to maximize their utility by offering external devices designed to fit together in a modular fashion. The 66.7-ms. (average access time) Ricoh drive mechanism comes inside a sturdy metal case with two cable connectors as well as rear power-in and outlet connectors. It does not support 1,024-byte-sector disks.

The same cases are used to house each of the ten external storage devices SST sells. Adapter and power connectors and terminators are all you need to daisy chain these boxes and form stacks. Of course, you will also need a SCSI card, in this case the 16-bit 7000-FASST2, Version 3.36, from Western Digital (Irvine, California; 714-932-5000). Front-mounted indicator LCDs inform the user of each component's SCSI address.

Even with little documentation, the Storage Stak II is relatively easy to set up, thanks largely to the manual that came with the Western Digital SCSI card. Universally applicable details, such as how to set the SCSI device addresses and how to connect the stacks, are explained here. Though SST claims that a full-blown manual will be available soon, it could not provide us with a copy.

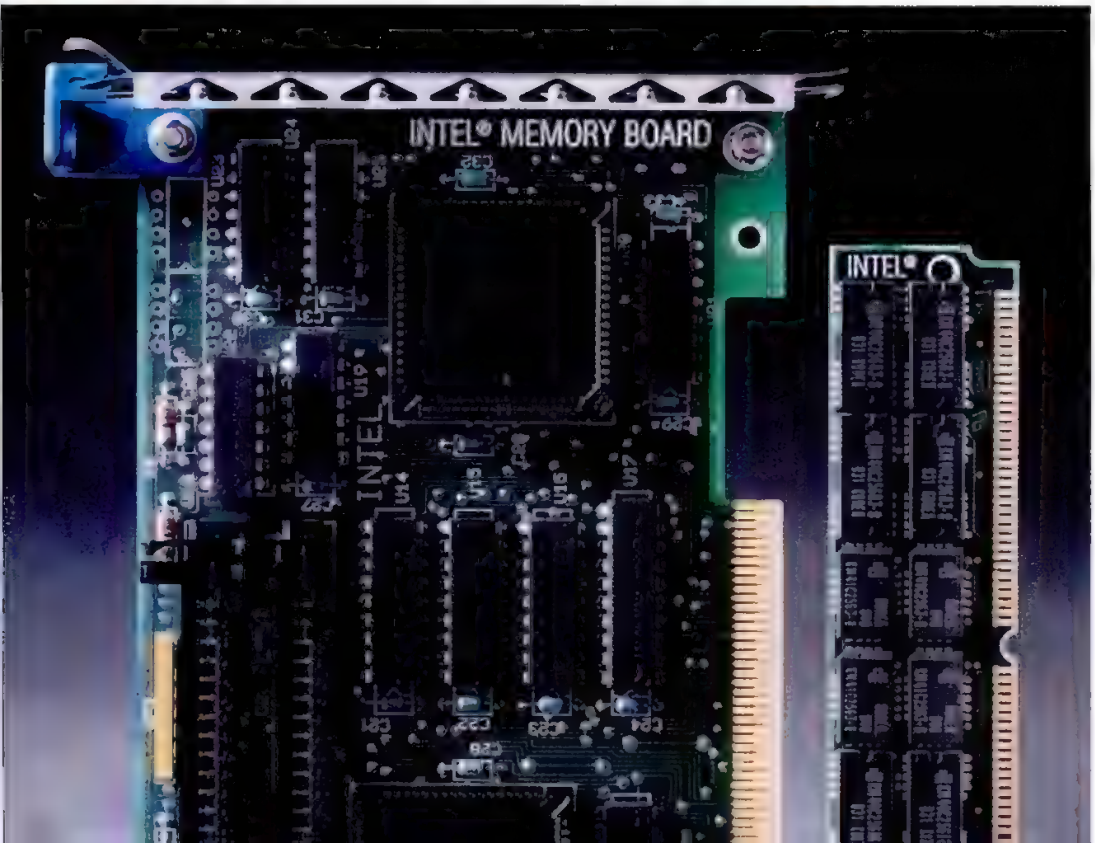
All this is a great idea, but unfortunately the magneto-optical drive proved extremely slow on PC Magazine Labs' tests. The Storage Stak II is the slowest tested subsystem on both DOS File Access tests and on the DOS Disk Access test. On the XCOPY tests, it came in second-slowest. The Western Digital card comes bundled with Columbia Data Products disk utilities

FACT FILE

SST Storage Stak II
Specialized Systems Technology, 3628 Westchase Dr., Houston, TX 77042; 800-688-8993, 713-781-8993.
List Price: With interface kit, $4,422; additional media, $165.
Requires: DOS 3.3 or later, 512K RAM.
In Short: SST's speciality is low-priced modular external storage. Unfortunately, its Ricoh-based Storage Stak II ended up the weakest link in our daisy chain.

CIRCLE 817 ON READER SERVICE CARD

Power.



(Altamonte Springs, Florida; 407-869-6700); SST, however, does not recommend their use for backup purposes, so the scores shown here cannot be mitigated by a comparison to the potential speed such software can provide.

These performance problems may be related to SST's unfamiliarity with the PC market. At the time we tested the drive, the Storage Stak II had only been out a few months. SST says it has never been tested officially with PCs. Even though the drive supports SCSI, the stapled stack of photocopied instructions labeled "preliminary" documentation mainly discussed the product's use with Sun SPARCstations and DEC VAXes.

SST has an interesting warranty arrangement. The $4,422 price for the MO package represents its cost with the standard one-year parts-and-labor deal; the customer pays to ship the part back, and SST returns the part using the same shipment method. For an additional $600, the company offers a 24-hour replacement option where it ships any needed parts overnight whenever a customer requests them. Finally, an on-site maintenance contract, provided by different organizations in different parts of the country, costs $950 more than the standard price.

The Storage Stak II's modularity and slim price make for an interesting product on the surface. But considering SST's lack of recognition for the PC market and the subsystem's poor performance, it could only catch the eye of confident SCSI users who don't require speed.

STORAGE DIMENSIONS INC.

SD LaserStor Erasable Optical 650 MB

by Bill O'Brien

At $5,295, Storage Dimensions' LaserStor Erasable Optical 650 MB is one of the more expensive units in this review. The Sony drive, packed in Storage Dimensions' 5.7- by 7.7- by 14.75-inch enclosure, has solid credentials with its 107.5-millisecond average access time.

> The SD LaserStor's documentation contains too much information and too little focus.

Unfortunately, after close examination we found this subsystem suffers from lackluster performance, and its documentation presents an unusual installation hurdle.

A lack of documentation isn't the LaserStor's problem. If anything, the documentation contains too much information but it fails from too little focus. The Hardware Installation Guide shows you how to install the unit and covers a plethora of possible interface cards. If you have a problem with the installation at this point, the guide refers you to the Hardware Reference Manual.

Once you install the hardware, the Software User's Guide shows you which driver to load and how to use *SpeedStor* (La-

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CIRCLE 749 ON READER SERVICE CARD

serStor's included setup software) to prepare your cartridge (512-byte-sector disks only). With everything up and running, the Technical Support and Service Guide and the user manual for Cheyenne Software Inc.'s *ARCserve/Solo Optical* backup software help you get service during the standard one-year parts-and-labor warranty (Roslyn, New York; 516-484-5110).

With the exception of the la'ter manual, Storage Dimensions would better service its customers with consolidated documentation that deals specifically with the subsystem they're installing. Most likely, this could be done in under ten pages. The firm's installation software choice, *SpeedStor*, makes this all the more necessary.

SpeedStor is like the good-natured aunt who simply can't resist poking her nose into every nook and cranny of your life. It has a voracious desire to seek out information about your computer, even from CMOS, and do something—anything—with it. After giving up on skipping from one voluminous manual to another, we misinterpreted some of *SpeedStor*'s screen options under the mistaken impression that they referred to the magneto-optical drive. Seconds later, the test-bed Compaq Deskpro 386/25e's hard disk was promptly reformatted. Thereafter, *SpeedStor* refused to recognize the internal hard disk because the wrong drive parameters had been set for it within *SpeedStor*'s own drive table.

All the information needed to prevent this disaster and correct the problem is contained in the *SpeedStor* documentation, but with so much information to wade through and such a variety of volumes, the manuals easily become a redoubt of last resort rather than a primary resource. It's an unfortunate situation because once you actually realize *SpeedStor*'s capabilities, you will quickly recognize that it is an excellent disk manager, MO or otherwise.

FACT FILE

SD LaserStor Erasable Optical 650 MB
Storage Dimensions Inc., 2145 Hamilton Ave., San Jose, CA 95125; 408-879-0300.
List Price: With interface kit, $5,295; additional media, $255.
Requires: DOS 3.*x* or later, 512K RAM.
In Short: Humdrum performance, a weighty price, and unfocused documentation place the Sony-based LaserStor on the low end of the scale.

CIRCLE 616 ON READER SERVICE CARD

The SD LaserStor's setup software is the good-natured aunt who simply can't resist poking her nose into every nook and cranny of your life.

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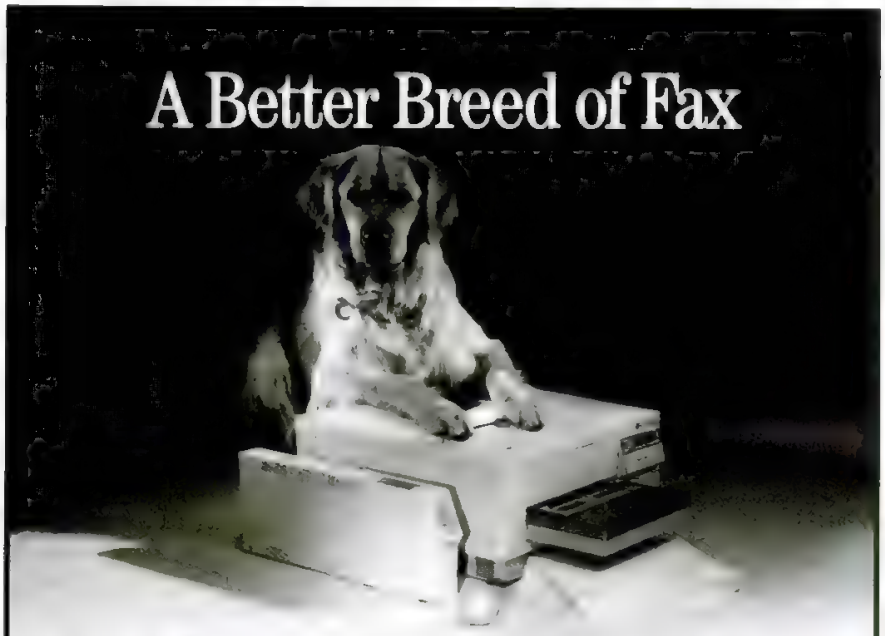

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CIRCLE 530 ON READER SERVICE CARD

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CIRCLE 147 ON READER SERVICE CARD

While the drive and its supplied Adaptec (Milpitas, California; 408-945-8600) controller are versatile enough to perform as either an additional drive or as the boot drive for your system, the LaserStor's performance is hardly up to the task of being your main storage device. On PC Magazine Labs' tests, the subsystem consistently turned in slower-than-average scores. Transferring the test-bed of directories and files from a hard disk to the optical disk drive required an agonizing amount of time. And even though the trip back was accomplished much more speedily, even this score did not stand out very much from the unit's peers.

Locked as it is into humdrum performance and anchored to its gaggle of manuals, the premium price of the LaserStor makes it difficult to recommend.

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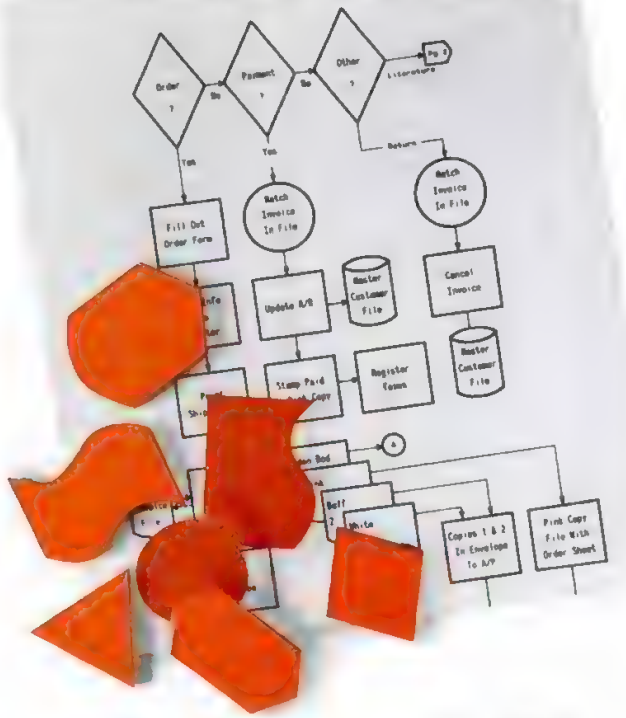

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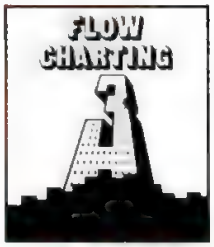

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CIRCLE 301 ON READER SERVICE CARD

TECMAR INC.

Tecmar LaserVault

by M. David Stone

Tecmar's LaserVault is just the sort of magneto-optical drive you would expect from a company whose tape drive subsystems have an impeccable reputation. Built around a 107.5-ms. (average access time) Sony drive mechanism, the LaserVault comes well equipped with automated installation and a backup utility for using the magneto-optical subsystem as a virtual tape drive. That and its strong performance may allow it to stand up to its heady price, $6,885—the most expensive drive tested.

> The LaserVault's consistently solid performance helps justify its high-end price tag. It is also one of the more feature-laden products reviewed here.

On our tests, the LaserVault produced average or slightly faster-than-average results on every test. The LaserVault package also supports 1,024-byte-sector disks. Formatted with the larger sector size, the drive performed better on some tests and worse on others. On our XCOPY from Winchester to Magneto-Optical test, for example, the 1,024-byte-sector disks were slower, but they easily surpassed the 512-byte-sector disks when copying from the MO to the Winchester. Compared with other drives, though, the LaserVault remained a slightly faster than average performer, no matter which sector size it supported.

Many of its competitors performed better on some tests and not as well on others, but not the LaserVault. Its consistently solid performance helps justify its high-end price tag. The test package came complete with a 16-bit SCSI board and cable, but

FACT FILE

Tecmar LaserVault
Tecmar Inc., 6225 Cochran Rd., Solon, OH 44139; 800-624-8560, 216-349-1009.
List Price: With interface kit, $6,885; additional media, $295.
Requires: DOS 3.1 or later, 640K RAM.
In Short: Though the Sony-based LaserVault is the most expensive drive in our roundup, it offers strong performance and is well supplied with features.

CIRCLE 619 ON READER SERVICE CARD

Tecmar also sells an MCA interface kit for $795 and a Macintosh interface kit for $295. Maximum capacity on a 1,024-byte-sector disk is the standard 325MB per side, with a maximum partition size of 310MB. Optional software is also available for Novell *NetWare 286* and *NetWare 386* and for several versions of Unix.

One notable feature is the LaserVault's ability to handle on a single disk partitions for more than one operating system. Current choices are for DOS, Macintosh, and AUX (though AUX is only an option if you create the partition on the Macintosh version of the package). You can also exchange data between DOS and Macintosh environments.

Data exchange is handled through a proprietary partition type called backup/interchange. The partition works with the *LaserBack* program to turn the MO drive into a virtual tape drive. Backing up with *LaserBack* is far faster than with XCOPY. And since the proprietary partition is accessible to the *LaserBack* software in both DOS and Macintosh environments, you can backup from and restore to either environment.

Setting up the LaserVault is straightforward. Plug in the 16-bit Adaptec (Milpitas, California; 408-945-8600) AHA-1540B SCSI card, plug a cable between card and drive, and plug a power cord into the drive unit. To install the software, you copy the files to your hard disk, including the two driver files that take up about 35K. You then use the install program to automatically add the required device lines to your CONFIG.SYS file.

The installation software also offers a quick setup option to partition the MO disk as a single DOS partition, a single backup/interchange partition, or split it evenly between the two. For more-complex needs, you can manually define the partitioning and optionally add other kinds of partitions. The manual is generally well organized and contains a thorough discussion of how to set up SCSI devices.

Clearly, the LaserVault is one of the more feature-laden packages in this review. Its solid performance times and even faster backup speed when using the *LaserBack* software, ability to have different partitions on a single disk for multiple operating systems, and ability to exchange data with other environments are all noteworthy features. If you need them, they may well be enough to justify the premium price.

XYXIS CORP.

Xyxis XY 600RW

by John R. Quain

Unlike baseball, in business you often get only two swings at bat: Sluggers in the computer marketplace must score a hit in either price or performance. This time at bat, the most the Xyxis XY 600RW achieved is a walk.

The XY 600RW's 66.7-ms. (average access time) Ricoh drive package has a midrange price of $4,995 (including your choice of DOS 3.3, 4.01, or Compaq DOS 3.31 operating systems). The ISO version comes with a 16-bit Adaptec (Milpitas, California; 408-945-8600) SCSI controller card that is capable of supporting a total of seven drives. The package also includes connecting cables, installation software,

> The XY 600RW's options won't count for much if speed in the DOS environment is what you're after. The drive posted some of the lowest scores in our roundup.

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Seagate ST251-1 40MB, 28ms, MFM, HH	219	224	265
Seagate ST277R-1 65MB, 28ms, RLL, HH	249	254	289
Seagate ST296N 80MB, 28ms, SCSI, HH	319	324	369
Seagate ST4096 80MB, 28ms, MFM, FH	489	494	529
Seagate ST4144R 120MB, 28ms, RLL, FH	549	554	589
Seagate/Imprimis ST4182E 160MB, 17ms, ESDI FH	779	INQUIRE	
Seagate/Imprimis ST4182N 155MB, 17ms, SCSI, FH	789	INQUIRE	
Seagate/Imprimis ST4350N 307MB, 18ms, SCSI, FH	1239	INQUIRE	
Seagate/Imprimis ST4384E 329MB, 15ms ESDI FH	1289	INQUIRE	
Seagate/Imprimis ST2383E 337MB, 16ms, ESDI HH	1295	INQUIRE	
Seagate/Imprimis ST2383N 338MB, 16ms, SCSI, HH	1325	INQUIRE	
Seagate/Imprimis ST4766E 676MB, 16ms, ESDI, FH	1679	INQUIRE	
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Seagate ST157R 50MB, 28ms, RLL, HH	239	243	283
Seagate/Imprimis ST1100 88MB, 15ms, MFM, HH	599	605	647
Seagate/Imprimis ST1182N 142MB, 15ms, SCSI, HH	679	INQUIRE	
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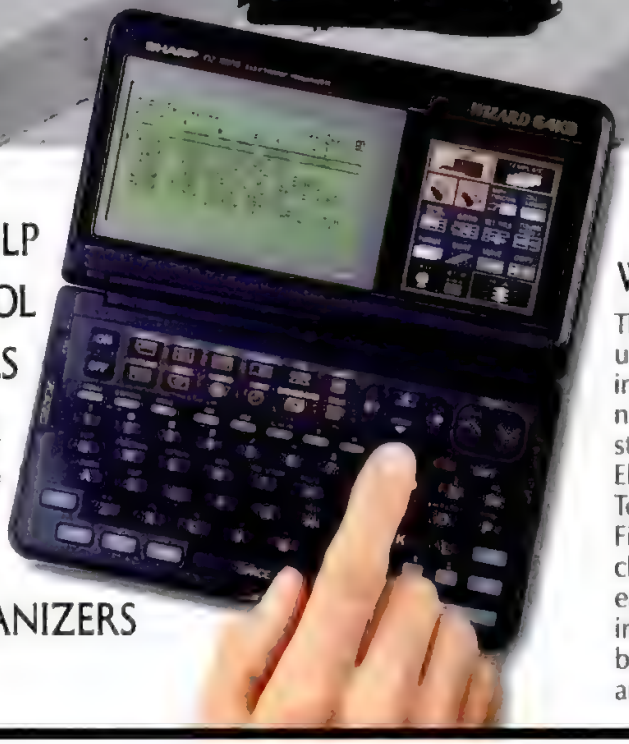

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CIRCLE 193 ON READER SERVICE CARD

and diagnostics. The MO driver's conventional memory demands are a reasonable 22K.

The XY 600RW's maximum storage capacity is restricted because it does not support 1,024-byte-sector disks. However, the subsystem does allow users to partition disks into one primary partition and 20 secondary partitions.

Utilizing these partitions, you can store data from different operating systems on these disks, but the XY 600RW will not allow you to use the same files on different platforms. In order to work with other environments, Xyxis offers a variety of separate interface kits, including OS/2, Versions 1.1 and 1.2, for $695; Unix (AT&T 3.22; SCO; and Xenix, Versions 2.3 and 3.2) for $1,095; Novell *NetWare 286* and *NetWare 386* for $1,095; Sun (Sun3, Sun4, and SPARCstations) for $1,295; and Macintosh and Amiga adapters for $250.

But these options won't count for much if speed in the DOS environment is what you are after. Results for the DOS File Access (small records) test placed the XY 600RW in the bottom of the pack. Its large-record-access results proved no better, with the XY 600RW posting one of the slowest scores in our roundup. The subsystem's backup-and-restore times, though not quite as disappointing, were still off the pace.

To get more swings at bat, Xyxis will have to offer more aggressive pricing and improve its performance.

Xyxis is a company solely dedicated to magneto-optical technology. This dedication manifests itself in the XY 600RW's documentation, which is helpful, and its software. However, in order to get more swings at bat, Xyxis will have to offer more aggressive pricing and improve its unalluring performance. ■

FACT FILE

Xyxis XY 600RW
Xyxis Corp., 14631 Martin Dr., Eden Prairie, MN 55344; 612-949-2388.
List Price: With interface kit, $4,995; additional media, $200.
Requires: DOS 3.3 or later, 512K RAM.
In Short: Though Xyxis touts its devotion to optical storage, its Ricoh-based XY 600RW came with unaggressive pricing and below-average performance.

CIRCLE 620 ON READER SERVICE CARD

Bill O'Brien, Winn L. Rosch, and M. David Stone are contributing editors of PC Magazine. *Kellyn S. Betts, Henry Fersko-Weiss, and John R. Quain are free-lance writers and frequent contributors to* PC Magazine.

CIRCLE 281 ON READER SERVICE CARD

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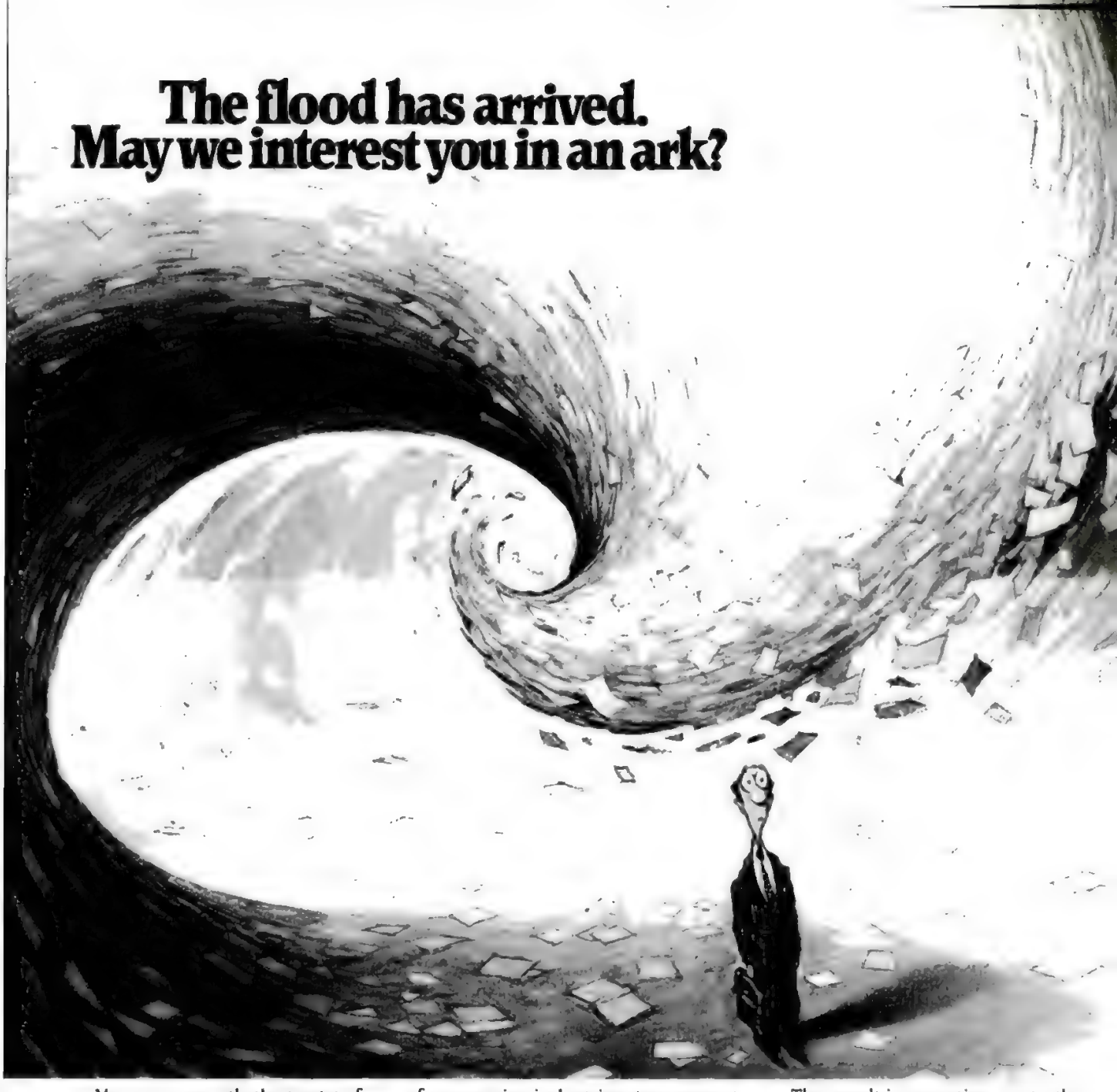

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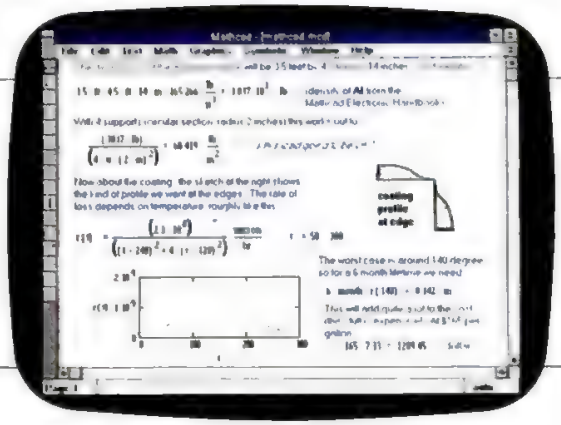
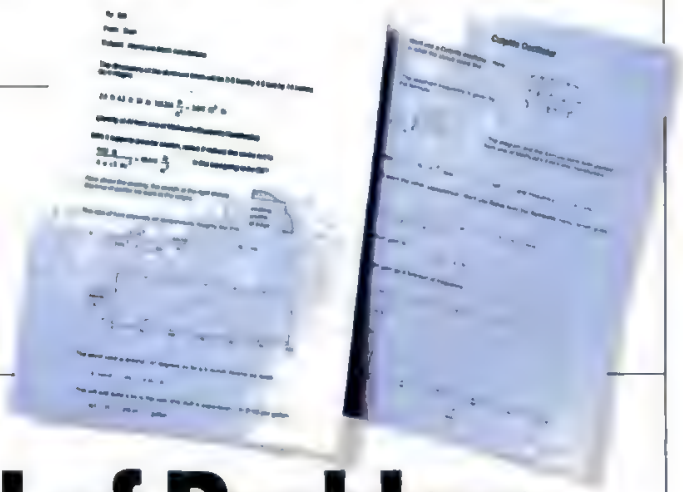
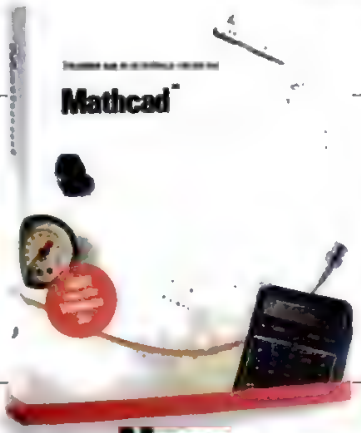


Solved.



Easy.



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CIRCLE 154 ON READER SERVICE CARD

by
Andrew Schulman

Lab Notes

Windows 3.0: All That Memory, All Those Modes

Microsoft Windows 3.0 can be pleasant to use—after someone else has set it up. If you're the someone else, however, *Windows* can be quite another story—three stories, in fact.

The kinds of questions you need to answer are these: What utilities can I run from the *Windows* DOS Prompt? Will *Windows* work with my network printer? How do multiple DOS prompts interact with that TSR I loaded before loading *Windows?* Which DOS-extended applications can I run? How does *Windows* interact with memory managers like *QEMM-386* and *386MAX?*

The answers to such questions usually depend on which *Windows* mode you're in. Almost any statement about *Windows* 3.0 capabilities is meaningless unless it specifies Real, Standard, or 386 Enhanced mode. It's very possible for two people to get into a heated discussion over how *Windows* behaves in a certain situation, only to discover, after an hour of debate, that they're talking about entirely different *Windows* modes.

This Lab Notes will take a closer look at the three modes of *Windows*, focusing especially on the biggest question for users and developers straining at the DOS 640K leash: How much memory can I get for my programs? In order to examine the benefits and limitations of each *Windows* mode, we'll use a series of small C programs that allocate as much memory as possible on your system. You can download these test programs from PC MagNet (for instructions, see the PC MagNet News page immediately following this issue's Utilities column) or compile them from the source code shown in the figures.

Does *Windows* help break the MS-DOS 640K barrier? The answer to this question depends, we will see, not only on which mode *Windows* is running in, but also on whether we are talking about a *Windows* or a DOS program, and what *type* of DOS program. We will see that *Windows* really has more than three modes!

We will also see how the Real, Standard, and 386 Enhanced modes of *Windows* 3.0 relate to the so-called real, 16-bit protected, 32-bit protected and Virtual 86 modes of the Intel microprocessors. And by the time we're finished examining these things, we will see that there is at least some method behind the *Windows* mode madness.

■ Understanding how *Windows* 3.0 interacts with your CPU's modes will help you give programs all the memory your system can provide.

THE BARE FACTS

The bare facts are easily stated. *Windows* 3.0 Real mode requires a PC with an Intel (or Intel-compatible) 8086 or 8088 (or later) processor and 640K of conventional memory. Standard mode requires an 80286 (or later) and at least 1MB of memory (640K conventional plus 384K extended). And Enhanced mode requires either an 80386 or 80486 processor and at least 2MB of memory.

When you enter WIN at the DOS command prompt, *Windows* will automatically attempt to select the highest possible mode that your hardware configuration supports. Unfortunately, the only way you can find out which mode *Windows* has decided to use is to look in the About dialog box, which you access from the Program Manager Help menu. (Programmers will want to note that there is a *Windows* function, GetWinFlags(), that a *Windows* program can use to determine the current mode.) You can force *Windows* to try to use a different mode by entering WIN /R, WIN /S, or WIN /3 at the DOS command prompt.

Because it exploits special features of the Intel 80286 processor, Standard mode offers benefits that are not available in Real mode. In the same way, because it takes advantage of special features of the Intel 80386 CPU, 386 Enhanced mode provides benefits that are not available in Standard or Real modes. The architectural features of each *Windows* mode are summarized in Figure 1.

The meaning and practical advantages of these features will become clearer as we move along. The bottom line, however, is this:

- Real mode is useful only for running old *Windows* 2.*x* applications that have not yet been converted to *Windows* 3.0. In my opinion, Real mode should probably have been left out of *Windows* 3.0 entirely.
- Standard mode is useful for running *Windows* programs on 286-based machines, and in this mode, *Windows* 3.0 programs can break the 640K DOS memory barrier. Unfortunately, Standard mode does not provide DOS programs with this same memory assist. Standard (and Real) modes do, however, provide DOS programs with task switching.
- 386 Enhanced mode offers many benefits both to *Windows* and DOS programs. In 386 Enhanced mode, the graphical user interface (GUI) is simply one—and not necessarily the most important—*Windows*

feature. *Windows* programs break the 640K DOS barrier, and (as we'll see later) by using the DOS Protected Mode Interface (DPMI), DOS programs can do so as well. The 386 Enhanced mode also offers virtual memory and preemptive multitasking of windowed DOS sessions. (*Preemptive multitasking* allows an environment like *Windows* to run several different tasks at the same time, even without any cooperation from those tasks. This is in contrast to nonpreemptive multitasking, which requires a certain level of cooperation (such as frequent calls to the *Windows* GetMessage() or PeekMessage() functions) from any program that wants to participate in multitasking.)

This last advantage of 386 Enhanced mode may require a little explanation. In Real and Standard modes, DOS programs can be run only full-screen and only task-switching between them is possible. In Enhanced mode, however, *Windows* can multitask several DOS programs, in resizable windows, just as if they were *Windows* applications. DOS programs can even run in the background, so you can download files from PC MagNet in one DOS session while simultaneously writing an article for *PC Magazine* in another. Furthermore, Enhanced mode furnishes an Interrupt 2Fh interface that allows these DOS programs to interact with *Windows* via the clipboard.

It's important to note, however, that the advantages of Enhanced mode come at the expense of a decrease in speed, when compared with Standard mode running on the same hardware. You can see this easily by running Norton's System Information (SI) or any other program that produces a similar performance index. The following numbers, which are meaningful only in relation to each other, were obtained using a 16-MHz Compaq 386:

Mode	SI
DOS	17.6
WIN /r	17.6
WIN /s	17.6
WIN /3	16.8 (full screen DOS Prompt)
WIN /3	14.6 (windowed DOS Prompt)
WIN /3	13.7 (windowed,background DOS Prompt)

SHOWING THE 640K BARRIER

Our first test program, MEM, is a DOS program designed to show you how much memory is available to your programs under DOS or any of the three *Windows* modes. As indicated below, even when running on a machine with 2MB of memory, you'll find that MEM never allocates more than around 560K.

Mode	Bytes
DOS	573,440
WIN /r	522,240
WIN /s	532,480
WIN /3	563,200

You can go to the store, buy a few more megabytes of memory, and install it on the machine, but when you run MEM again, it will *still* allocate less than 640K! (Try convincing a friend who uses a Macintosh or any other non-DOS computer that this makes sense!) Whether you run MEM outside *Windows*, or under *Windows* in any mode, it will never allocate anything close to the amount of memory actually installed on the machine.

Programmers will not find MEM a particularly exciting program: it simply allocates as much memory as possible, by calling the C malloc() function in a loop. The program keeps count of how many bytes it has allocated, and when malloc() returns failure (indicating that memory is exhausted), it breaks out of the loop. Compiling MEM using C's large model maximizes the amount of memory the program can allocate under DOS. The figures above are for a version of MEM compiled with Turbo C; when compiled with Microsoft C, it consistently gets 82K less in each configuration. The C code for the program is shown in Figure 2.

You might think that we could just use DOS function 48h to allocate 0FFFFh

THE THREE MODES OF WINDOWS 3.0

USING REAL MODE:

- *Windows'* kernel runs in real mode
- *Windows* task-switches (rather than multitasks) DOS programs
- Most of *Windows* is swapped out when a DOS program runs
- DOS programs cannot be windowed
- DOS progams run in real mode or, using a DOS extender, in protected mode
- *Windows* programs run in real mode
- You can run old *Windows* 2.x programs

USING STANDARD MODE:

- *Windows'* kernel runs in 16-bit protected mode
- The *Windows* DOS extender and DOS Protected Mode Interface (DPMI) are available to *Windows* programs, but not to DOS programs
- *Windows* task-switches (rather than multitasking) DOS programs
- Most of *Windows* is swapped out when a DOS program runs
- DOS programs cannot be windowed
- DOS programs run in real mode or, using a DOS extender, in protected mode
- *Windows* programs run in 16-bit protected mode
- All *Windows* programs share the same protected-mode Local Descriptor Table (LDT)

USING 386 ENHANCED MODE:

- Portions of *Windows'* kernel run in 32-bit protected mode
- Virtual device drivers use 32-bit protected mode
- The *Windows* DOS extender and DPMI are available to *Windows* programs *and* DOS programs
- *Windows* programs run in 16-bit protected mode
- *Windows* programs can have 32-bit protected-mode components
- DOS programs can run in Virtual 86, 16-bit protected, or 32-bit protected mode
- *Windows* provides virtual memory
- *Windows* multitasks (rather than task-switching) multiple DOS programs
- DOS programs can run in the background
- *Windows* uses preemptive multitasking of DOS programs (in contrast, *Windows* programs in all modes use nonpreemptive, cooperative multitasking)
- DOS programs can run in a window; *Windows* is still available while DOS programs are running
- Each DOS prompt gets its own virtual machine
- All *Windows* programs share the same protected-mode Local Descriptor Table (LDT)
- All *Windows* programs run in a single virtual machine

Figure 1: The basic architecture of *Microsoft Windows* 3.0 determines the limits and capabilities of each of its three modes—Real, Standard, and 386 Enhanced.

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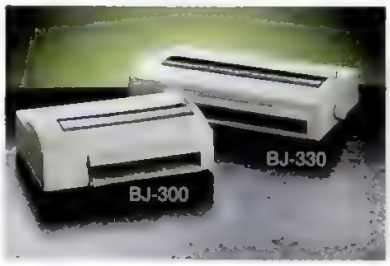

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CIRCLE 187 ON READER SERVICE CARD

paragraphs and then, when it fails (as it must) check the BX register for the *actual* number of paragraphs available. Why does MEM go through the motions of multiple allocations?

There are two reasons why MEM instead uses a malloc() loop. First, we want this code to be portable to protected mode; as we will see later, in protected mode a request for 0FFFFh paragraphs might very well succeed (this, indeed, is the whole point of using a DOS extender!).

Second, when checking for available memory, it is usually better to see how much memory you can actually allocate. Most *Windows* users are familiar with the absurdly high numbers the Program Manager displays as the amount of available memory; we want to see how much we can really get.

You should understand that when running a DOS program like MEM in Real and Standard modes, *Windows* shrinks itself down to a small (less than 50K) stub in memory. In Real mode, this stub is KERNEL.EXE; in Standard mode, it is called DOSX.EXE KRNL286. Either way, the remaining memory is free for use by the DOS program.

In Enhanced mode, on the other hand, *Windows* does *not* shrink itself down when running a DOS program. And yet, as the numbers show, the DOS program has a little more memory available than in Real and Standard modes. We'll see later how Enhanced mode accomplishes this feat by using several special features of the 80386 and 80486 processors. For now, the point to note is simply that whatever the *Windows* mode, the MEM program derives no particular memory management benefits from running under *Windows*.

Actually, that's not quite true. Any given *instance* of the MEM program derives no advantage from running under *Windows*, but you can run *multiple copies* of the program at the same time. You can thus start several large DOS programs at the same time under *Windows*.

This multi-instance capability extends to all three *Windows* modes. In Real and Standard modes the number of copies of MEM you can start at the same time is limited only by available disk space. In these modes, *Windows* behaves towards DOS programs as a task switcher (in fact, very much like the one that is forthcoming in DOS 5.0's DOS Shell). When you switch away from a DOS program—with Ctrl-Esc, for example—*Windows* saves its state in a ~WOA*xxxx*.TMP swap file. (The WOA stands for WINOLDAP; non-*Windows* DOS programs are considered old applications.)

In 386 Enhanced mode, *Windows* does not *task-switch* DOS programs: it *multitasks* them. Programs are not swapped to disk on an application basis. Instead, any disk swapping occurs at the level of the 4K pages used in 386-based virtual memory. This more-sophisticated virtual-memory technique means that although Enhanced mode can run several DOS programs at the same time (particularly handy for running telecommunications programs in the background), it can actually *start* fewer simultaneous DOS programs than can Real or Standard modes. There ain't no such thing as a free lunch.

To summarize: MEM provides a vivid demonstration of the MS-DOS 640K barrier. When you run the program, it allocates less than 640K bytes of memory. *Windows* Real and Standard modes provide task switching, and 386 Enhanced mode achieves multitasking, but although this allows us to run multiple instances of the program, any given instance is held back by the 640K barrier. That MEM can *at best* allocate 560K on a 2MB machine should come as a shock, but by now most PC users accept this rather counterintuitive situation as a fact of life.

We will now see that it isn't.

MEM.C — COMPLETE LISTING

```
/*
MEM.C -- How much memory can we allocate under MS-DOS?

Microsoft C: cl -AL mem.c
Turbo C:     tcc -ml mem.c

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    PC Magazine * Andrew Schulman
*/

#include <stdlib.h>
#include <stdio.h>

#define SIZE    16240

main()
{
    unsigned long bytes = 0;
    char *p;

    while (p = malloc(SIZE))
    {
        *p = 'x';
        p[SIZE-1] = 'y';
        bytes += SIZE;
    }

    printf("Allocated %lu bytes\n", bytes);
    printf("Press ENTER to release memory...");
    getchar();
    return 0;
}
```

Figure 2: MEM.C allocates all available memory either in DOS or in any *Windows* mode. Because of the 640K barrier and the size of the operating system, a maximum of approximately 560K is to be expected; compiled under Microsoft C instead of Turbo C, MEM will show about 82K less.

GOODBYE, 640K BARRIER

The next program, WINMEM, does essentially the same thing as MEM, except that instead of a small DOS program, it is a small *Windows* program that allocates all available memory. The screenshots shown in Figures 4 through 6 tell the story more fully, and we'll return later to an important detail they contain. For now, however, as the summary figures below indicate, running on the same 80386 machine with 2MB of memory, the program allocates radically different amounts of memory under *Windows* Real, Standard, and 386 Enhanced modes.

Mode	Bytes
WIN /r	229,376
WIN /s	1,245,184
WIN /3	3,080,192

In Real mode, WINMEM allocates even *less* memory than the DOS program

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THE VCPI BACKLOG

by Andrew Schulman

Now that Microsoft provides support for running protected-mode programs under DOS, the once-crucial Expanded Memory Specification (EMS) and Extended Memory Specification (XMS) should diminish in importance. From now on important PC applications will probably either expect to be running in protected mode under *Windows* or will use a DOS extender. EMS and XMS were both vital workarounds that are really no longer necessary.

But what of the many *existing* PC applications that require EMS or XMS? *Windows* presents no major obstacle to this, for both *Windows* Real and Standard modes are compatible with installed memory managers. *Windows* 386 Enhanced mode alone is incompatible with many existing memory managers. On the one hand, there are upgrades available, such as Quarterdeck Office System's *QEMM-386* 5.11, that are compatible with 386 Enhanced mode; and on the other hand, Enhanced mode has its own built-in expanded-memory manager. In Enhanced mode, the amount of XMS and EMS memory can be set on an application-by-application basis, using the PIF Editor.

Problems remain, however. For example, *Windows* users have repeatedly experienced compatibility problems trying to run DOS-extended applications in Enhanced mode.

The key word here is *VCPI:* Virtual Control Program Interface, developed by Quarterdeck and Phar Lap Software. Since protected-mode DOS extenders are based on the assumption that a program will start off in real mode, something special is needed for DOS extenders to operate if the machine is running in Virtual 86 mode instead.

Until DPMI was incorporated into *Windows* 3.0, this something special was VCPI. It's basically a set of functions that extend the INT 67h instruction used in EMS. DPMI is in many ways a vast improvement over VCPI, but until (and if) the world moves to DPMI, there is an enormous backlog of applications that need VCPI to let you run them from Virtual 86 mode. VCPI is much easier for vendors to implement than DPMI, so there are many existing VCPI-compatible applications. In Enhanced mode, DOS programs start off in Virtual 86 mode, yet VCPI is not provided.

If you've ever tried to run *AutoCAD/386* in Enhanced mode, you've encountered this problem. *AutoCAD/386* was built with a Phar Lap 386|DOS-Extender, which does not yet support DPMI. As soon as *AutoCAD/386* or any other program checks to see whether VCPI is present (by calling INT 67h AX=DE00h), it is terminated by *Windows* Enhanced mode with the following message:

> **As applications are upgraded to DPMI, the whole VCPI/*Windows* issue will disappear.**

```
Error: You have attempted to run
a protected-mode application in
386 enhanced mode. To run the
application, exit and run Windows
using either the WIN /s or the WIN
/r command.
```

This can be turned off with `VCPI-Warning=false` in the [386enh] section of the SYSTEM.INI file. But the offending application will still print out its own error message:

```
The 386 chip is currently
executing in virtual 8086 mode
under the control of another
program. You must turn off this
other program in order to use
386|DOS-Extender to run in
protected mode.
```

Unfortunately, this statement is true. Protected-mode DOS applications that are not DPMI-compatible must be run either in Real or Standard mode. The only way around this is for someone (is anybody listening?) to write a *Windows* virtual device driver that supports the VCPI extensions to the EMS specification.

There is a further problem. *Windows* 3.0 Standard and 386 Enhanced modes require an XMS driver—usually HIMEM.SYS. *Windows* will refuse to start in either Standard or 386 Enhanced mode unless such a driver is present. But, just as many DOS extended applications are not yet DPMI-compliant, many are not XMS-compliant either. 386|DOS-Extender 3.0 supports the XMS specification, but it may be some time before applications such as *AutoCAD/386* incorporate this new version. (You can determine the 386 |DOS-Extender version an application uses by issuing the DOS command `SET DOSX=-BANNER` just before running it.)

The upshot is that *even if you are not running Windows,* if you have HIMEM.SYS installed, many protected-mode DOS applications will not have enough extended memory to run in. HIMEM.SYS is taking all the extended memory, and such applications do not know how to use XMS.

This problem, at least, has a partial solution. Upgraded versions of memory managers, such as *QEMM-386* 5.11, can be used instead of HIMEM.SYS. *QEMM-386* 5.11 provides both XMS and EMS out of the same shared memory pool. Thus, *QEMM-386* 5.11 can be used to supply VCPI-compliant EMS memory when *AutoCAD/386* wants it, and can supply XMS when *Windows* 3.0 wants it.

As protected-mode DOS applications and memory managers are upgraded to DPMI (*Lotus 1-2-3,* Release 3.1, and Phar Lap 286 | DOS-Extender are two early examples) or when someone puts enhanced VCPI support unto *Windows*, the whole VCPI/*Windows* issue will disappear. ■

MEM. Thus, when it comes to memory management, *Windows* Real mode brings absolutely nothing to the party.

In Standard mode, WINMEM allocates an amount of memory that—for the first time—makes sense. We start with 2MB of memory, and WINMEM allocates 1.3MB; obviously, *Windows* itself takes up some space. In any case, the 640K barrier disappears.

Lastly, in Enhanced mode . . . wait a minute! If there's only 2MB of memory on this machine, how could WINMEM allocate 3MB? If you glance back at the list of architectural features shown in Figure 1, you'll note that in Enhanced mode "Virtual memory is provided." Now you see what that means. In Enhanced mode, *Windows* can use your hard disk as a source of memory. And because we're using the same copy of WINMEM.EXE as we did in Real and Standard modes, it's clear that this virtual memory is provided without any special handling by the program. (Note: If you run WINMEM in Enhanced mode and it does not allocate more memory than you have, delete some files from your hard disk and try again.)

Now we can also see why *Microsoft Windows* 3.0 has been so successful. It's not so much that it looks a lot better than *Windows* 1.*x* and 2.*x* (although that does help), but the significant advance is the vastly increased amount of memory—and consequent vastly improved performance—that is available in Standard and Enhanced modes. For the first time, PC users can regard *Windows* as a practical tool rather than just as a fascinating experiment.

Programmers may have snickered when I described WINMEM as a *small Windows* program. You've undoubtedly heard the claim that "it takes 100 lines of code just to print "hello world" under *Windows*." But that isn't really true. For simple experiments, small utilities, and the always-fashionable "hello world" example, programs can use the *Windows* MessageBox() function rather than taking on the full-blown *Windows* burden of registering a window class, creating a window, and handling messages.

The MessageBox() function can handle up to a full screenload of information, which makes it perfect for small *Windows* utilities and experiments like our WINMEM example. Using MessageBox(), we can even build a function much like the standard C printf() function.

While requiring only 75 lines of code, WINMEM *does* have an insatiable appetite for memory. WINMEM runs the *Windows* GlobalAlloc() and GlobalLock() functions in a loop. It only breaks out of the loop when these functions fail, indicating that memory is exhausted. It then prints out the count of bytes allocated, along with some other information (and misinformation, such as *Windows*' own GetFreeSpace() count of available bytes). The source code, WINMEM.C, together with compilation instructions, is shown in Figure 3.

Programmers will also note that WINMEM.EXE itself is only 5K—smaller than the DOS program, MEM.EXE. Yet its capabilities are far greater and (of course) its output is a lot prettier. The explanation is that because *Windows* provides dynamic linking, the code for functions used by WINMEM, such as MessageBox(), GlobalAlloc(), and GetFreeSpace(), is not copied into each program that uses it. These functions are not part of the famous *Windows* Software Development Kit (SDK) either. Rather, the entire *Windows* API is located right inside every copy of *Windows* that someone buys off the shelf at his local retailer. Even the wvsprintf() function used in WINMEM is located inside *Windows*. A *Windows* program like WINMEM has *dynamic links* to all this code, not the code itself. For that reason, the executable file is quite small.

WINMEM.C — COMPLETE LISTING

```
/*
WINMEM.C -- How much memory can we allocate under Windows?

cl -c -AS -Gsw -Oais -Zpe winmem.c
link /align:16 winmem,,,/nod:slibcew libw,win.def
rc winmem.exe

; WIN.DEF -- generic Windows .DEF file
EXETYPE     WINDOWS
STUB        'WINSTUB.EXE'
CODE        PRELOAD MOVEABLE DISCARDABLE
DATA        PRELOAD MOVEABLE MULTIPLE
HEAPSIZE    10240
STACKSIZE   5120

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    PC Magazine * Andrew Schulman
*/

#include <stdlib.h>
#include <stdarg.h>
#include <string.h>
#include <ctype.h>
#include <time.h>
#include <dos.h>
#include "windows.h"

/* printf to a Windows MessageBox */
int msgprintf(char *fmt, ...)
{
    static char s[1024];
    int len;
    va_list marker;
    va_start(marker, fmt);
    len = wvsprintf(s, fmt, marker);
    va_end(marker);
    MessageBox(NULL, s, "PC Magazine Windows Memory Allocation Test", MB_OK);
    return len;
}

/* return name of current Windows mode */
char far *win_mode(void)
{
    unsigned long flags = GetWinFlags();
    return (flags & WF_ENHANCED ? "Enhanced" :
            flags & WF_STANDARD ?         "Standard" :
            /* default */                 "Real") ;
}

int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
    LPSTR lpszCmdLine, int nCmdShow)
{
    unsigned long blksize = 32L << 10L;     /* 32k per block */
    unsigned long freespace, largest, allocated, save;
    time_t t1, t2;
    char far *fp;

    /* retrieve these BEFORE we start allocating memory */
    freespace = GetFreeSpace(0);
    largest = GlobalCompact(-1);

    /* allocate as much memory as possible */
    time(&t1);
    allocated = 0;
    while (fp = GlobalLock(GlobalAlloc(GMEM_MOVEABLE, blksize)))
    {
        *fp = 'x';
        fp[blksize-1] = 'y';
        allocated += blksize;
        save = fp;
        Yield();    /* Let another program run */
    }
    time(&t2);

    /* display results */
    msgprintf("Running in %s mode\
        \n%lu bytes available\
        \n%lu bytes in largest block\
        \nAllocated %lu bytes in %lu seconds\
        \nSample pointer: %04X:%04X\n",
            win_mode(),
            freespace, largest, allocated, t2 - t1,
            FP_SEG(save), FP_OFF(save));

    /* allocated memory will be freed automatically on exit */
        return 0;
    }
```

Figure 3: WINMEM.C shows the wide disparities in memory available to *Windows* programs.

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THE INTEL MODES

The reason WINMEM behaves sensibly in Standard mode and spectacularly in Enhanced mode (while barely limping along in Real mode) is that in Standard and Enhanced modes *Windows* programs now run in yet another mode: the *protected* mode of the Intel 80286, 80386, and 80486 microprocessors.

Just as *Windows* itself has too many modes, so also does the Intel 80x86 microprocessor family. The 80286, 80386, and 80486 microprocessors have a compatibility mode in which these advanced CPUs essentially pretend to be old 8088s—the processors used in the original IBM PC and PC-XT. Because the addresses that a program uses for its code and data in this compatibility mode have a direct correspondence to the real, genuine addresses that are put out on the system bus, it is called *real mode*.

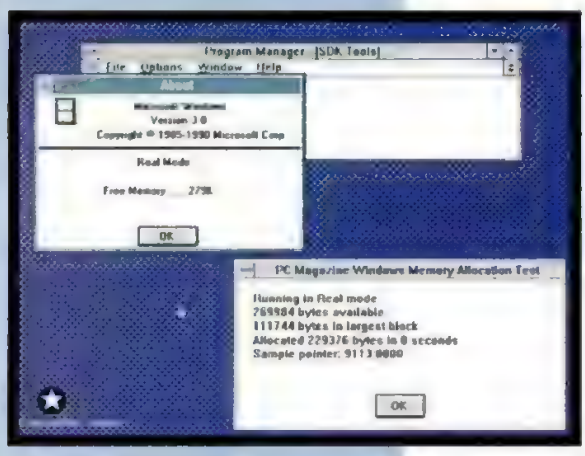

Figure 4: WINMEM running under *Windows* 3.0 Real mode (WIN /R) shows even less memory than is available to a regular DOS application.

Most DOS machines today—even the most powerful 80486s—are normally run in this old-fashioned, 8088-compatible mode. When used this way, the machines are essentially fast XTs. Because the 8088 could address only 1MB of memory, an 80286, 80386, or 80486 running in real mode can also address only 1MB—no matter how much memory is installed in the machine. Real mode operation is what accounts for a DOS machine's remarkable ability to ignore all the extra memory you've installed.

Indeed, because DOS reserves certain ranges within this 1MB address space for video display memory and other important functions, a program running in real mode DOS actually has *less* than a megabyte available for programs' use: a maximum of 640K, to be exact. Now we know who the culprit is; real-mode operation under DOS is what produces the 640K barrier.

The true native modes of the 80286 (and higher) CPUs are called *protected*. Here the processors no longer behave like fast 8088s, and programs do not use absolute (real) memory addresses. Instead, in protected mode, programs access memory indirectly, through descriptor tables that are maintained by a protected-mode operating environment such as *Windows*.

The system is "protected" in the sense that the processor uses the descriptor tables to validate a program's memory accesses. While memory access is less direct than in real mode, the indirection is largely invisible to programs, and *much more* memory can be allocated. The 1MB limitation of real mode, and the resulting 640K limitation of DOS, simply disappear.

The use of protected mode in Standard and Enhanced modes is the most exciting advance of *Windows* 3.0. Making *Windows* a protected-mode DOS extender has finally solved the problem of living with DOS on 80286, 80386, and 80486 machines. These machines are just too powerful for the old operating system; without protected-mode software such as *Windows* 3.0, a lot of that power goes to waste.

But since protected mode is the native mode of the 80286, 80386, and 80486, why did it require three versions of *Windows* to take this seemingly obvious step?

The reason is simple: compatibility. The moment a program moves into protected mode, it gives up the ability to run on IBM PCs and XTs, and there are still a lot of those machines around. Only recently has Microsoft decided it could junk 8088 compatibility in new *Windows* programs. Even so, Microsoft hedged its bets—and generated tremendous confusion—by keeping a *Windows* mode that uses the processor's real mode.

Windows Real mode will probably die of disuse. And except for this remnant, *Windows* programs now run in protected mode. We need to be more specific here, however, for the Intel processors have several *different* protected modes:

- *16-bit protected mode* was introduced on the 80286; it is also available on the 80386 and 80486. As with real mode, 16 bits (2 bytes) determine the maximum size of a segment: 2^{16}, or 64K. Unlike real mode, a 16-bit protected-mode program can hypothetically allocate 16,384 such segments: 1K megabytes. In Standard mode, *Windows* programs run in 16-bit protected mode, and so does *Windows* itself.
- *32-bit protected mode* was introduced on the 80386; it is also available on the 80486. Here, programs use the full 32-bit (4-byte) registers of the processor. The number of bits still determines the maximum size of a segment, which now rises to 2^{32}, or 4 gigabytes. Since this is the potential size of one segment, programs need just one segment, which is effectively like not having to bother with segments at all. This is sometimes called the *flat model*.

In Enhanced mode, portions of *Windows* programs *can* run in 32-bit protected mode, using the WINMEM32 dynamic link library (DLL). Unfortunately, however, WINMEM32.DLL appears to be too difficult for ordinary mortals to use. In Enhanced mode, portions of *Windows* itself *do* run in 32-bit protected mode. The so-called virtual device drivers (VxDs) used in Enhanced mode are flat-model 32-bit programs. (Unlike other device drivers, which exist largely to implement *Windows* device independence, VxDs exist to serialize access to devices from multiple *virtual machines*. They give each virtual machine the illusion that it has its own keyboard, coprocessor, DMA device, and so forth.)

- Finally, *Virtual 86 (V86) mode* was also introduced on the 80386; it's also available on the 80486. V86 mode is essentially a 1MB protected mode. A program running in V86 mode thinks it is running in real mode; in fact, it is running under the control of a V86 Control program.

In Enhanced mode, DOS programs are in fact running in V86 mode; *Windows* 3.0 in Enhanced mode is a V86 Control program (so are expanded memory managers such as *QEMM-386* and *386MAX*). In Enhanced mode, DOS programs can use the

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DOS Protected Mode Interface (DPMI) to switch into either 16-bit or 32-bit protected mode; we will examine this capability in detail later.

Unfortunately, DOS programs cannot access DPMI in Standard mode. They can use any DOS extender, however, even one that's not DPMI compatible, so long as it is compatible with XMS (the XMS Memory settings in a *Windows* .PIF file would need to be changed to provide the DOS extender with XMS extended memory). Examples are DOS extenders from Phar Lap, Rational Systems, and Ergo Computing. Regrettably, many DOS-extended applications cannot yet run in Enhanced mode (see the sidebar "The VCPI Backlog").

EXAMINING WINMEM

After this whirlwind tour of the Intel modes, it's time to put on our programmer's hats once more and take a closer look at the WINMEM program and its behavior in the three *Windows* modes.

Referring to Figure 3 again, WINMEM uses the C dereferencing operators `*fp` and `fp[]` to prove that it has a genuine pointer that holds a directly usable address to genuine, directly accessible memory. After all, we must run the same copy of WINMEM.EXE in Enhanced mode as in Real mode. The fact that in Enhanced mode we will be using virtual memory (that is, phony memory located on a hard disk) is completely invisible to the program. In all three modes the address returned by the *Windows* GlobalLock() function is always an Intel segment:offset pointer, just waiting to be peeked or poked (read or written).

However, the *xxxx* portion of an *xxxx:yyyy* pointer has a different meaning in protected mode than it does in real mode. And herein lies the key to understanding why protected mode offers a larger amount of memory than real mode.

Look again at Figures 4, 5, and 6. In addition to displaying how much memory it allocated, WINMEM also prints out the address of the last block of memory it assigned. In Real mode, WINMEM displays the address 9113:0000. In Standard and Enhanced modes, it displays addresses like 1065:0000 or 0DA5:0000.

The value 9113 is a typical segment paragraph address for a real-mode program. It points to absolute memory location 91130h. In real mode, many other segment:offset combinations (such as 9110:0030 or 9100:0130) point to the exact same location. To turn an *xxxx:yyyy* real-mode pointer into an absolute memory location, the processor merely multiplies *xxxx* by 16 and then adds it to the *yyyy* part. There are 2^{16}, or 65,536 (64K), different values for *xxxx;* multiplying this by 16 yields 1,048,576—that is, 1MB. Because of the way pointers are interpreted by the processor in real mode, you can only access 1MB of memory—even if you have 2MB, 7MB, or 10MB installed.

While real mode obviously gives your machine a bad case of tunnel vision, it does have the advantage of making direct access to absolute memory locations extremely simple. If you want to access address 400h, any number of pointers will do, including 0000:0400 and 0040:0000.

Now look at the values shown for protected mode: 1065:0000 and 0DA5:0000. Recall that these were the *xxxx* portion of a typical *xxxx:yyyy* pointer returned from GlobalLock() in *Windows* Standard and Enhanced modes. If these worked like real mode addresses, they would be pointing to absolute memory locations 10650h and 0DA50h—way too low in memory for *Windows* to be allocating! The first time PC programmers see such numbers in a pointer, they are often convinced that something is wrong: These can't be valid addresses for GlobalLock() or malloc() to be returning.

Welcome to protected mode! In protected mode, the *xxxx* portion of an *xxxx:yyyy* pointer is called a *selector*, not a *segment*. Moreover, *it has no relation whatsoever to an absolute memory location*. What then *does* a protected-mode address correspond to? If WINMEM is poking `*fp = 'x'` and the value of `fp` is 0DA5:0000, what does this mean in terms of absolute, physical memory location? And how is all this related to the fact that when our program gets these funny pointers it also seems able to allocate a lot more memory? After all, this is what makes any of this important in the first place.

A protected-mode selector (the *xxxx* portion of an *xxxx:yyyy* address that a protected-mode program peeks, pokes, or executes) is an index into a table of *descriptors*. A descriptor contains the base address, size, and access rights of a block of memory. Every time a program uses one of the CS, DS, ES, or SS segment registers, the processor uses the information from the descriptor to carry out (or forbid) the actual memory access.

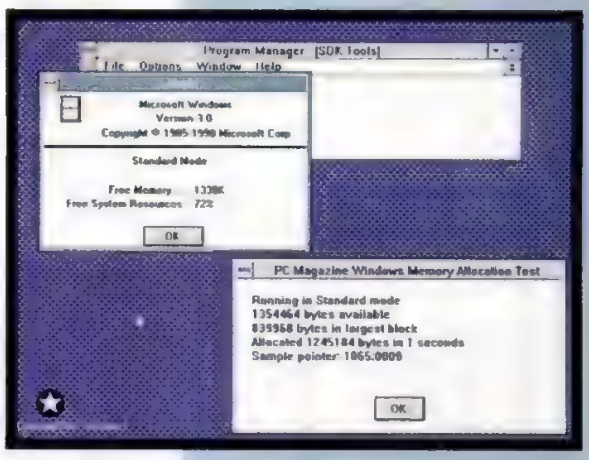

Figure 5: WINMEM running under *Windows* 3.0 Standard mode (WIN /S) reflects the actual 2MB memory installed in the machine.

The preceding paragraph contains about half a dozen oversimplifications, but as a basic description of protected mode in the 80x86 family, it will do. The key point is that the

```
absolute memory location
 = (segment * 16) + offset
```

formula of real mode has been replaced in protected mode by what is basically a

```
absolute memory location
 = descriptortable[selector].base
 + offset
```

formula.

That explains why we can potentially allocate a lot more memory in protected mode. We're constrained only by the number of potential descriptors multiplied by the maximum size a descriptor can represent, not by the rigid 64K multiplied by 16 rule of real-mode addressing.

This brief description also explains why protected mode makes life much easier for

the programmer who is using *Windows* memory management functions. In protected mode, the base address for the pointer 0DA5:0000 is whatever the descriptor for 0DA5 says it is. If *Windows* needs to move this segment around in memory (as it probably did when we were allocating all the available memory), it can update the descriptor, and WINMEM's selector 0DA5 remains unchanged. With protected mode, all of *Windows*'s memory management tricks finally become invisible to *Windows* programs. The GMEM_MOVEABLE flag for GlobalAlloc() and the GlobalLock() function are practically meaningless in protected mode.

Since the actual layout of descriptors, descriptor tables, and selectors in 16-bit and 32-bit protected mode has been widely published in many other sources, I will not show them here. If you're interested, see Ray Duncan et al., *Extending DOS*, Reading, Mass.: Addison-Wesley, 1990; or Rakesh K. Agarwal, *80x86 Architecture and Programming*, Volume II, *Architecture Reference*, Englewood Cliffs N.J.: Prentice Hall, 1991; or Jeff Prosise, "Segmented Memory," *PC Magazine*, March 26, 1991, pages 395 to 399.

BREAKING THE BARRIER WITH DOS APPS

WINMEM shows why writing *Windows* 3.0 programs is important: Standard and Enhanced modes give you a lot more memory. Many programmers who haven't the slightest interest in the *Windows* GUI will probably port their programs to *Windows* just to be able to break the 640K barrier.

But isn't there any way to provide this benefit to non-*Windows* DOS programs that run under *Windows*? Do we really have to buy into the entire *Windows* world view, just to get more memory?

No, we don't. Several times in this article, I've mentioned the DOS Protected Mode Interface (DPMI), and Ray Duncan has described it in his Power Programming column in *PC Magazine*'s February 12 and February 26, 1991, issues. I'll concentrate here on showing how a DOS program running under *Windows* can use DPMI to break the 640K barrier; in the next issue's Lab Notes we'll see how *Windows* programs can use DPMI to compensate for some omissions in the *Windows* API.

DPMIMEM.EXE is a DOS program that uses the DPMI server in *Windows* Enhanced mode to switch an 80386 or 80486 processor into protected mode. While *Windows* programs can use DPMI in either Standard or Enhanced mode, DOS programs (at least in *Windows* 3.0) can use DPMI only in Enhanced mode. If it's run in Real or Standard mode, or if run outside *Windows*, DPMIMEM displays an error message. But in Enhanced mode DPMIMEM—which begins life as a normal DOS program—responds like this:

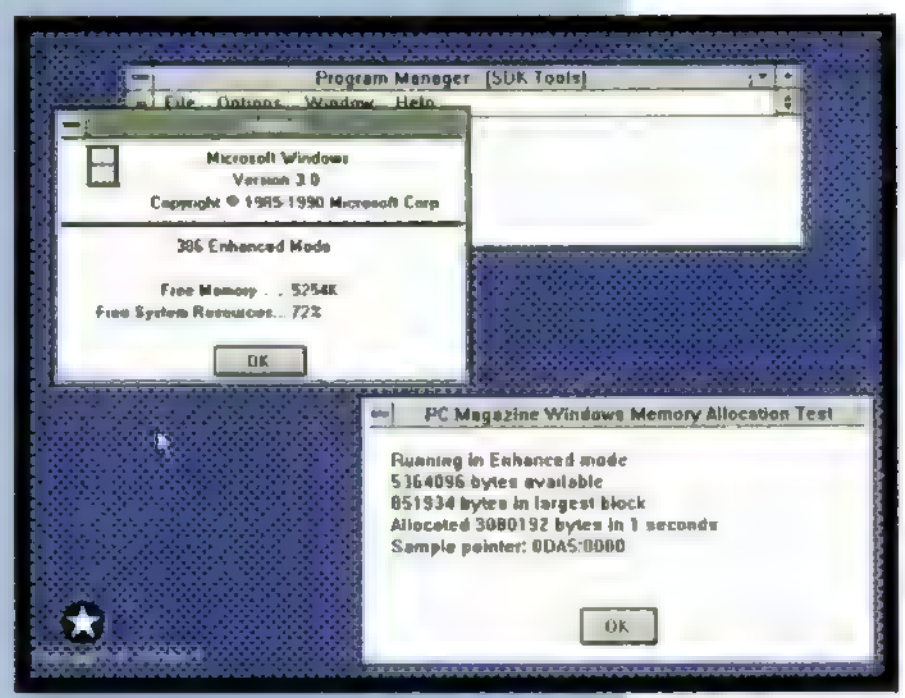

Figure 6: WINMEM running under *Windows* 3.0 386 Enhanced mode (WIN /3) provides additional virtual memory by making use of the PC's hard disk.

```
DS=1321 CS=11D3 in real mode
DS=008D CS=0095 in protected mode
Allocated 1200000 bytes in 3
 seconds
```

I'll discuss the first two lines of this output in a moment. For now, the point to note is the last line: A regular DOS program, compiled with Microsoft C or Turbo C, has allocated 1.2MB of memory—more than twice as much as the MEM program. True, we've had to run the program under *Windows* Enhanced mode to access this memory, but DPMIMEM is not itself a *Windows* program.

As with our previous MEM and WINMEM example programs, the memory allocated by DPMIMEM is directly accessible. In contrast to the bank-switched memory provided by the Expanded Memory Specification (EMS), all allocated memory is accessible, at any time, to a program that uses DPMI. Likewise, in contrast to the Extended Memory Specification (XMS), memory above the 1MB line is just as useful as memory allocated from conventional memory: DPMIMEM does not need to copy this memory anywhere in order to use it. The big difference between allocating memory in protected mode and using workaround approaches such as EMS and XMS is that in protected mode, all memory is equally accessible. With DPMI, the distinctions between conventional, extended, and expanded memory simply disappears.

Exactly how does a DOS program use DPMI to break the 640K barrier? Programmers will be particularly interested in the DPMIMEM.C listing that is shown in Figure 7. After compiling with Microsoft C or Turbo C, DPMIMEM can be run under *Windows*. The DPMI server in *Windows* Enhanced mode supports both 16-bit and 32-bit protected-mode DOS applications. The DPMIMEM.C program is 16-bit.

DPMIMEM.C starts off by invoking a function called dpmi_init(), which determines whether DPMI services are available. If they are, it uses them to switch into protected mode.

As seen in dpmi_init(), a program that wants to use DPMI begins by invoking INT 2Fh AX=1687h. If DPMI is available, this function returns several pieces of information, including the address of the DPMI *Real to Protected Mode Switch Entry Point* function. By then calling this function, the program is switched into protected mode.

This is magic. In DPMIMEM, we display the values of the DS and CS registers before and after calling the DPMI mode-switch function. Before calling the mode-switch function, DPMIMEM is running in real mode, and DS and CS hold values such as 1321h and 11D3h. When the mode-switch function returns, DS and CS have suddenly been changed to protected-mode selector values such as 008Dh and 0095h. The program's segment registers all change in midstream!

The C mode-switch code in dpmi_init() makes heavy use of in-line assembler and looks like this:

DPMIMEM.C — COMPLETE LISTING

```c
/*
DPMIMEM.C -- Demonstrates DPMI and Windows 3.0 DOS extender

Microsoft C: cl -AS dpmimem.c
Turbo C:     tcc -ms dpmimem.c

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    PC Magazine * Andrew Schulman
*/

#ifdef __TURBOC__
#pragma inline
#define _asm                    asm
#define _dos_allocmem(x,y)      (allocmem(x, y) != -1)
#else
#define MK_FP(seg, ofs) \
    ((void far *) (((unsigned long) (seg) << 16) | (ofs)))
#endif

#include <stdlib.h>
#include <stdarg.h>
#include <stdio.h>
#include <time.h>
#include <dos.h>

typedef enum { FALSE, TRUE } BOOL;

/* Call MS-DOS Terminate Process with Return Code function
   (INT 21h AH=4Ch), in either real or protected mode */
void dos_exit(unsigned err)
{
    _asm mov al, err
    _asm mov ah, 4Ch
    _asm int 21h
}

/* Call Windows Release Time-Slice function (INT 2Fh AX=1680h) */
void win_yield(void)
{
    _asm mov ax, 1680h
    _asm int 2Fh
}

/* Call the Windows Enhanced Mode Install Check function
   (INT 2Fh AX=1608h) */
BOOL win_3enh(void)
{
    unsigned char vers;
    _asm mov ax, 1608h
    _asm int 2Fh
    _asm mov vers, al
    return (vers && !(vers == 0x00 || vers == 1 || vers == 0xFF));
}

void fail(char *s)      { puts(s); dos_exit(1); }
/* Call the DPMI Mode Detection function (INT 2Fh AX=1686h) to
   see if we are *already* running in protected mode under DPMI */
BOOL dpmi_present(void)
{
    unsigned _ax;
    _asm mov ax, 1686h
    _asm int 2Fh
    _asm mov _ax, ax
    return (!_ax);
}

/* Call the DPMI function for obtaining the Real to Protected
   Mode Switch Entry Point (INT 2Fh AX=1687h), to determine if
   DPMI is available and, if so, switch into protected mode by
   calling the Switch Entry Point */
BOOL dpmi_init(void)
{
    unsigned rds, rcs;
    void (far *dpmi)();
    unsigned hostdata_seg, hostdata_para, dpmi_flags;
    _asm mov ax, 1687h              // test for DPMI presence
    _asm int 2Fh
    _asm and ax, ax
    _asm jnz nodpmi                 // if (AX == 0) DPMI is present
    _asm mov dpmi_flags, bx
    _asm mov hostdata_para, si      // paras for DPMI host private data
    _asm mov dpmi, di
    _asm mov dpmi+2, es             // DPMI protected-mode switch entry point
    _asm jmp short gotdpmi
nodpmi:
    return FALSE;
gotdpmi:
    if (_dos_allocmem(hostdata_para, &hostdata_seg) != 0)
        fail("can't allocate memory");

    dpmi_flags |= 1;   /* this is a 16-bit protected-mode program */

    _asm mov rds, ds
    _asm mov rcs, cs
    printf("DS=%04X CS=%04X in real mode\n", rds, rcs);

    /* enter protected mode */
    _asm mov ax, hostdata_seg
    _asm mov es, ax
    _asm mov ax, dpmi_flags
    (*dpmi)();

    /* now in protected mode */
    _asm mov rds, ds
    _asm mov rcs, cs
    printf("DS=%04X CS=%04X in protected mode\n", rds, rcs);

    return TRUE;
}

/* Call the MS-DOS Allocate Memory Block function (INT 21h AH=48h),
   via the compiler's library function. The Windows DOS extender
   provides INT 21h AH=48h in protected mode. */
void far *my_malloc(unsigned bytes)
{
    unsigned seg;
    return (_dos_allocmem(bytes >> 4, &seg) ? 0 : MK_FP(seg, 0));
}

#define SIZE        28400

main()
{
    unsigned long bytes = 0;
    char far *fp;
    time_t t1, t2;

    if (!dpmi_present())
        if (!dpmi_init())
            fail("This program requires DPMI");

    /* now in protected mode */

    if (!win_3enh())
        puts("Running under DPMI, but not under Windows 3.x enhanced mode");

    /* allocation loop */
    time(&t1);
    while (fp = my_malloc(SIZE))
    {
        *fp = 'x';
        fp[SIZE-1] = 'y';
        bytes += SIZE;
        win_yield();
    }
    time(&t2);

    printf("Allocated %lu bytes in %lu seconds\n", bytes, t2 - t1);
    printf("Press ENTER to release memory...");
    fflush(stdout);
    getchar();
    dos_exit(0);
}
```

Figure 7: By switching into protected mode and taking advantage of the DPMI server within *Windows* 3.0, DOS programs can break the 640K barrier.

```
void (far *dpmi)();
asm mov ax, 1687h
asm int 2Fh
// ...
asm mov dpmi, di
asm mov dpmi+2, es
// ...
(*dpmi)();
// now in protected mode!
```

Once in protected mode, the program can either use other DPMI services (which are provided via interrupt 31h) or it can use the services of a DOS extender. A DOS extender is a program that makes the DOS interrupt 21h and the BIOS (interrupt 10h, and so on) services available in protected mode. One of the primary architectural features of *Windows* Standard and 386 Enhanced modes is that they are built around DOS extenders. In 386 Enhanced mode, this DOS extender can also be used by non-*Windows* applications.

After switching into protected mode in DPMIMEM.C, we use the *Windows* DOS extender to allocate memory. This is accomplished simply by calling the MS-DOS Allocate Memory Block function (INT 21h AX=48h). Whereas this function can never provide more than 640K in real-mode DOS, when a DOS extender offers a protected-mode function with this same interface, it provides potential entrée to many megabytes of memory.

Because a DOS extender provides INT 21h AX=48h in protected mode, we can

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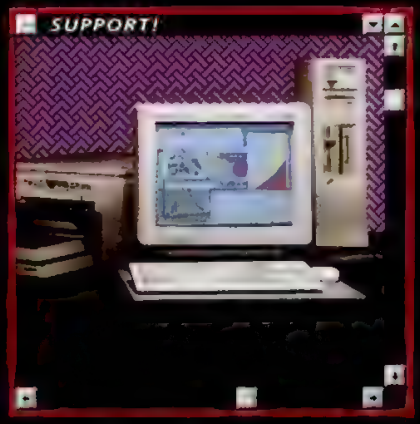

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use either the Microsoft C _dos_allocmem() function or the Turbo C allocmem() function, even though both expect to call this function in real mode. This works because transparent operation of DOS and BIOS functions in protected mode is the whole goal of a DOS extender.

It is important to note two other functions called in DPMIMEM.C. Even before calling dpmi_init(), DPMIMEM calls dpmi_present(). This in turn calls INT 2Fh AX=1686h, which tells us whether a program is *already* running in protected mode under DPMI. For example, dpmi_present() would return TRUE if called from any *Windows* program running in Standard or Enhanced mode. The call is included here because DPMIMEM might start off as a protected-mode rather than a real-mode program. (I'll discuss this in more detail later.)

Inside the DPMIMEM allocation loop, we call win_yield(), which in turn invokes INT 2Fh AX=1680h. Even though *Windows* Enhanced mode provides preemptive multitasking for DOS programs, calling this function assists the *Windows* scheduler.

All these interrupt 2Fh calls are part of a programmatic interface that *Windows* provides for non-*Windows* programs. INT 2Fh AH=16h and AH=17h are used for such services as DPMI, access to the *Windows* clipboard, access to the *Windows* multitasking scheduler, and so on. This is a whole topic in itself, and will perhaps be taken up in a future Lab Notes.

THE PROBLEM WITH DPMIMEM

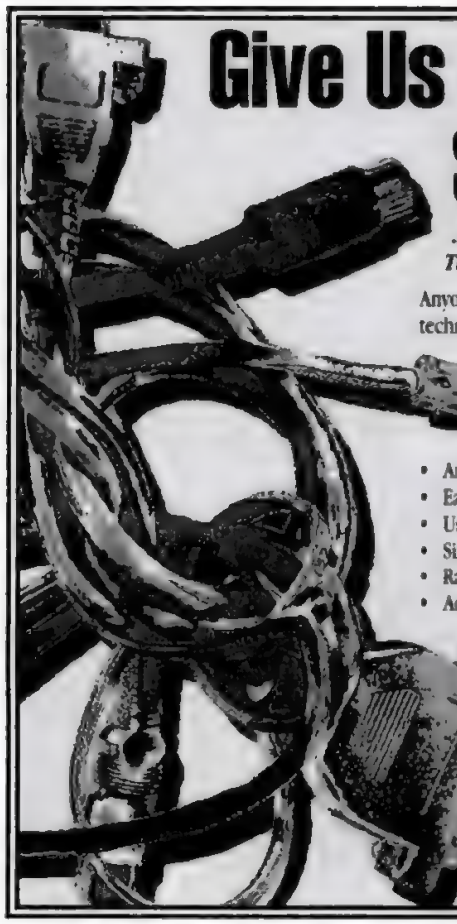
Before you get too excited about DOS programs using DPMI to break the 640K DOS barrier, there are several important qualifications to note.

First, remember that, for now at least, DPMIMEM requires *Windows* Enhanced mode. In Standard mode, only *Windows* programs can access DPMI; DOS programs can't. The reason is that Standard mode provides the INT 31h calls a program can use once it's running in protected mode, but it does *not* provide the INT 2Fh AX=1687h call needed to switch into protected mode in the first place.

Windows programs can make INT 31h calls and make use of the *Windows* DOS extender because these programs are *already* running in protected mode, so they don't need to call the DPMI mode-switch function. As noted earlier, the INT 2Fh AX=1686h call succeeds when called from a *Windows* program running in either Standard or Enhanced mode, indicating that the program is *already* in protected mode. But a DOS program can't switch into protected mode, because the INT 2Fh AX=1687h call isn't provided.

This illustrates the hybrid nature of *Windows* Standard mode. On the one hand, *Windows* programs run in protected mode, just as in *Windows* Enhanced mode. On the other hand, just as in *Windows* Real mode, DOS programs in Standard mode do not get special services, like DPMI. Thus, Standard mode is really two different modes: for DOS programs, it resembles Real mode; and for *Windows* programs, it resembles Enhanced mode.

Besides its restriction to Enhanced mode, DPMIMEM raises a number of other problems. First, DPMIMEM *must* be compiled with C's small model. Because calling the DPMI mode-switch function—`(*dpmi)()` in Figure 7—changes



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the program's segment registers without warning, library functions such as printf() will work only if they don't rely on segment registers. The compiler's small model is the only venue in which this is even possible. There's a certain irony that in a program designed to access enormous amounts of memory, we're restricted to the small model.

If DPMIMEM is compiled with anything other than small model (`cl -AS` in Microsoft C, and `tcc -ms` in Turbo C), the program will generate a *protection violation*. *Windows* then displays what has facetiously been called its "Programming Excellence Award"—a dialog box with a big Stop sign and the warning, "This application has violated system integrity and will be terminated."

Further—and again because the program's segment registers have been treated to the magic mode switch of the `(*dpmi)()` call—we can't use Microsoft's CodeView or Borland's Turbo Debugger to debug DPMIMEM. As soon as we step over the `(*dpmi)()` call, the debugger hangs. Because we're running in *Windows* Enhanced mode, we can throw away the DOS session with Settings/Terminate . . . and start again. But while the ability to throw away a crashed or hung DOS session is a wonderful feature of Virtual 86 mode, we still can't use a standard DOS debugger on DPMIMEM.

There are still more problems about DPMIMEM; for example, hitting Ctrl-C can sometimes cause a protection violation.

Why is DPMIMEM so rough? Why are there so many restrictions on using DPMI? The reason is that DPMI was not meant for use by application programs such as DPMIMEM, but rather by DOS extenders like Phar Lap's 386 | DOS-Extender and 286 | DOS-Extender, Rational Systems' DOS/16M, Ergo Computing's OS/286 and OS/386, and by the DOS extender in *Windows* itself. DPMI is an extremely low-level interface and is nothing like EMS or XMS, with which DOS programmers and users are familiar. The DPMI design committee expected that the services of DPMI "servers" like *Windows* would be directly used only by DOS extenders, which would then pass a higher level of functionality along to application programs.

To use DPMI without all these restrictions, you need a DOS extender that loads protected-mode DOS programs. DPMIMEM, by contrast, begins as a real-mode program and then switches into protected mode. A better solution would be to create a program that takes on all the hassles of switching modes, have this program switch into protected mode, and then load other programs. The other programs would then start off in protected mode, making life much simpler.

For example, a DPMI-compatible DOS extender, such as Phar Lap's 286 |DOS-Extender or Rational Systems DOS/16M, will afford DPMIMEM complete use of the C standard library in any memory model, will allow source-level debugging, and so on. To prepare DPMIMEM to use 286 | DOS-Extender, you use the Microsoft C `-Lp` (link protected) switch that's normally used for building OS/2 applications. You then enter

DPMI is an extremely low-level interface and is nothing like EMS or XMS with which DOS programmers and users are familiar.

```
run286 dpmimem
```

As a DOS extender, RUN286 handles all the mode switching. Now when DPMIMEM starts, it is *already* running in protected mode, so the call to dpmi_present() in DPMIMEM.C succeeds. Thus, dpmi_init() is not called. We can use Microsoft's protected-mode CodeView for source-level debugging:

```
cl -Lp -Zi dpmimem.c -link
 slibpe.lib

run286 \c600\binp\cvp dpmimem
```

You should note that CVP is actually CodeView for OS/2, but RUN286 makes it possible to run this as well as many other character-mode OS/2 executables under MS-DOS. When running under *Windows* in Enhanced mode, it uses DPMI services. The ability to run OS/2 executables under DOS is a perfect example of DPMI's potential.

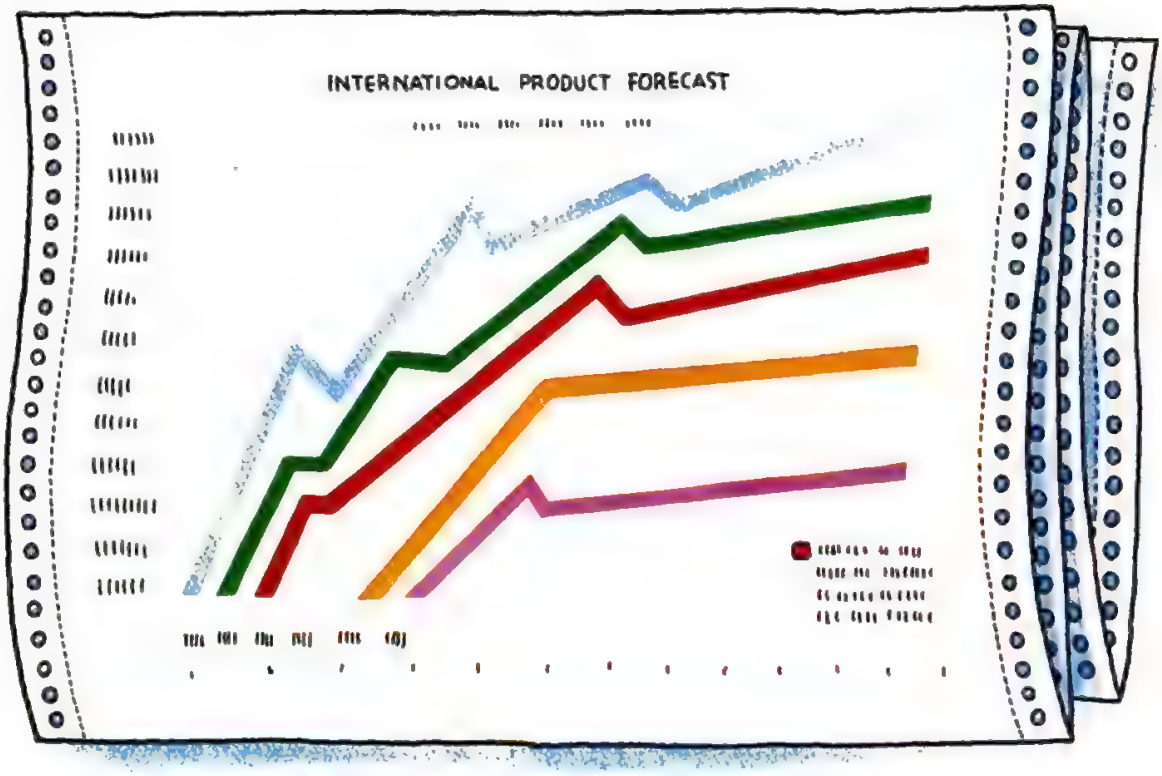
DPMI will largely be used by DOS extender vendors to build products like 286 | DOS-Extender. But clearly, some developers will opt to use DPMI directly, particularly in programs that have relatively small amounts of source code but also have prodigious memory requirements—at least when the necessity to run the program under *Windows* Enhanced mode is not overly restrictive.

There's an additional reason for developers to learn about DPMI. We've seen how good protected mode is at providing large amounts of memory. But protected mode also has its dark side. As I discussed earlier, in protected-mode, there is no connection between the selectors a program manipulates and the absolute memory locations in the machine. The fact of the matter is, however, that many existing PC programs rely on direct manipulation of memory for direct screen writes, peeking the BIOS data area, accessing undocumented DOS data structures, manipulating memory-mapped devices, and so on. This kind of manipulation becomes difficult in protected mode.

This presents a special problem for *Windows* programs. Because *Windows* programs now use protected mode in Standard and Enhanced modes (the only genuinely useful *Windows* modes), these programs run into a major obstacle when they want to directly manipulate absolute memory locations. Simply trying to peek an address—0040:006C, for example—causes an immediate protection violation. Even the enormous *Windows* API does not seem to include any functions for accessing absolute memory locations from protected mode. That means there's trouble ahead.

In the next issue, I'll show you how *Windows* programs can use DPMI to solve this problem. DPMI will provide them with complete access to the machine in Standard and Enhanced modes. Thus DPMI, originally intended for use by a handful of vendors in constructing DOS extenders, will end up being useful to a much wider group of PC programmers. ■

Andrew Schulman is an engineer and writer at Phar Lap Software, in Cambridge, Massachusetts. Editor of the recently published Undocumented DOS, *he also contributed to Ray Duncan's book,* Extending DOS.



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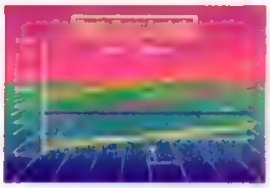

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As hard disk capacity increases, directories multiply, and paths lengthen, you invariably develop program conflicts: identically named programs or batch files in different places or .COM, .EXE, and .BAT files that have the same base name. When this happens, which of the conflicting programs actually executes will depend on where you are when you enter its name and where it is on your DOS PATH. Whenever a clash occurs within the same directory, .EXE always loses to .COM, and .BAT loses to either.

Conflicts such as these often go undetected, since you usually call the same programs from the same places. But if you add a new program, change a PATH or other environment variable, or write a new batch file, these conflicts are likely to surface. Given enough patience and a file-finding utility, you could always wait to deal with each conflict only when it became a problem.

A better solution, however, is to use this issue's free utility, CHKPATH. In addition to generating a variety of specifiable lists of the programs on your disk and informing you of conflicts among them, CHKPATH will also diagnose common problems with your DOS PATH itself.

The easiest way to get a working copy of CHKPATH.EXE is to download it from PC MagNet. Downloading instructions are given in the PC MagNet News page, which immediately follows this article. If your communications setup can't handle executable files directly, you can download CHKPATH.BAS instead. Running this file in BASIC will create CHKPATH .EXE. CHKPATH was implemented in C, and its source code can also be downloaded from PC MagNet.

If you don't have a modem, you can get a copy of the *source code* by mail or fax. Simply send a postcard with your name and address (or fax number if applicable) to the attention of Katherine West, Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016; no phone calls, please.

■ Same-named programs on your PATH can produce unpredictable results. This utility will show you where such .COM, .EXE, and .BAT files are, and which of them will actually execute.

USING CHKPATH

CHKPATH will give you a quick usage summary when you run it without any of the switches that determine which directories it is to search. Every parameter is optional, and the various switches and arguments can be entered in any order, combination, in upper- or lowercase. The program output can be redirected to a printer or a file by adding the usual > prn or > filename to the end of the command line.

The full syntax for CHKPATH is

```
CHKPATH [/a] [/d=drive(s)]
 [/s=dir1...dirn] [/e=var]
 [/n] [/p]
```

As it scans through your directories, CHKPATH gathers information about all executable files, but it normally displays only those that conflict. Specifying the /a (all) switch forces CHKPATH to list all the .COM, .EXE, and .BAT files it finds. Normally, too, CHKPATH shows all the file information contained in a normal DOS directory listing. If the /n (no details) switch is used, CHKPATH will not include the date, time, and size information. This conserves memory, so try it if CHKPATH runs out. (Note, though, that it is highly unlikely that this will happen.) Using the /p (pause) switch causes CHKPATH to halt the display scrolling at each screenful.

The /d=drive(s) switch tells CHKPATH to search every directory on all the drives you specify. Be sure to use the equal sign (=) where shown in this and the subsequent switch parameters. Putting a dash between designated drives causes the inclusion of the intervening drive letters, but no spaces between listed drives are permitted. Thus, for example, to check drives C:, D:, E:, F:, and H:, you would enter

```
CHKPATH /d=C:-F:H:
```

The /s=dir1 . . . dirn switch is used if you want to *specify* one or more directories to be searched. Specified directories need not be on a single drive, but each directory path should be separated from the one preceeding it by a single space. If you wanted CHKPATH to scan C:\DOS and D:\UTIL for example, you would specify them on the command line thus:

```
CHKPATH /s=C:\DOS D:\UTIL /a
```

The /e=var switch is used to specify a search based on a DOS environment variable. The usual *var* you'll want to enter will simply be PATH, so you can check for conflicts along the same route DOS will

follow in looking for your programs. You may, however, specify any other environment variable that designates directories. Indeed, by using more than one /e= switch, you can specify more than one environment variable for the same run of CHKPATH. The *var* you enter after /e= should be formatted in the same manner as the DOS PATH statement. So if you wanted to search the directories shown in the example above, all you would have to do is enter the following two commands at the DOS prompt:

```
SET TEMPPATH=C:\DOS;D:\UTIL
CHKPATH /E=TEMPPATH
```

Note that CHKPATH considers the directories contained in any environment variable you enter on the command line as "specified" directories in the sense explained below.

DOS PATH HANDLING

When you enter a command, unless it is one internal to DOS (for example, DIR), COMMAND.COM has to go to your disk drive to find and execute it. Unless directed elsewhere on the command line, if you enter CHKDSK at the DOS prompt, DOS starts looking for CHKDSK.COM in your current directory. If it's found there, the program will be loaded and run. If not, then COMMAND.COM looks for CHKDSK.EXE and runs that, if it's found. If it isn't found, COMMAND .COM finally looks for CHKDSK.BAT. If that file is found, it is opened and run. If not, COMMAND.COM turns to the DOS PATH for further search directions.

COMMAND.COM goes through the directories listed in the PATH statement in the same order you would read or type it, searching each listed directory for .COM, .EXE, and .BAT files. Thus, when a program is installed in a directory on the PATH, you don't have to remember which directory it's in. Usually.

Let's now assume that you install a new application containing (among others) files named CHKDSK.BAT and CC.EXE. Since you put the files in C:\NEWPROG, you modify your PATH statement to read

```
PATH=C:\;C:\NEWPROG;C:\DOS;D:\UTIL
```

CC will now execute from the DOS prompt as expected, but entering CHKDSK gets you a program you didn't know you had! Obviously, you'd figure this one out pretty quickly. But what if CHKDSK.EXE weren't something you ran manually? If it were in your AUTOEXEC or if neither the program you wanted, nor the program that was executed produced any visible output, it could be some time before you notice the problem.

You might then decide to fix it by inserting C:\DOS before C:\NEWPROG on your PATH thus:

```
PATH=C:\;C:\DOS;C:\NEWPROG;
C:\DOS;D:\UTIL
```

DOS will not warn you that you have repeated C:\DOS in the specification above.

> CHKPATH is aware of the DOS search order, so if you have a .COM and an .EXE file with the same base name in the same directory, CHKPATH will show you which among the conflicting programs will be run.

CHKPATH will. While not a very dangerous situation, it will slow down directory searches and make your PATH less comprehensible.

Meanwhile, you decide that the whole NEWPROG package isn't worth disk space, so you delete its files and remove its directory. That directory still remains listed on your search PATH, however, once again slowing down future searches. CHKPATH will remind you to remove the useless part of your PATH listing.

Another potential PATH problem that CHKPATH will detect is a listing like the following:

```
PATH=C:\;C:\DOS;C:NEWPROG
```

Here, the C:NEWPROG listing is a *relative* PATH specification. As long as your default directory for drive C: is the root, C:\NEWPROG will be on the PATH. But if you change to C:\DOS, when you enter CC, COMMAND.COM will search C:\DOS\NEWPROG instead of C:\NEWPROG. You may intentionally have a relative PATH specified, so this diagnostic warning doesn't necessarily indicate a problem. You might, for example, include ".." as a directory on your PATH. This means that the parent of the current directory is always searched, so if you store data files in directories immediately below the programs that created them, you can keep your PATH shorter.

PUTTING CHKPATH TO WORK

When you've downloaded CHKPATH, the first thing you might tell it to do is to check your PATH and the programs on it by entering

```
CHKPATH /e=path /n
```

This will start by detecting any relative, repeated, or nonexistent directories on your PATH and will then move on to give you a complete list of all program conflicts along it. Including the /n switch will give you a names-only rather than a full-detail listing. The displayed list will be ordered alphabetically by base name, within which the ordering will tell you which conflicting programs are closest to the front of the DOS PATH.

CHKPATH is also aware of the DOS search order, so even if you have a .COM and an .EXE file with the same base name in the same directory, CHKPATH will show you which among the conflicting programs will be run. (CHKPATH identifies it as the "Winner" in its listing.) You should note that a few applications, such as *DESQview*, intentionally start up with a .COM file that then loads an .EXE file with the same base name. Thus the presence of a DV.COM doesn't automatically mean that DV.EXE is unnecessary!

Diagnostic needs aside, you might next find it useful to print out a complete list of all the executable files on your PATH. To generate it, the syntax is

```
CHKPATH /e=path /a > prn
```

The /a parameter tells CHKPATH to list all the executable files it finds, even when there is no conflict. By removing the previous /n parameter, you get the file date,

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time, and size printed, telling you if you have the same-named programs in different directories. The hard copy lets you decide and mark at leisure which duplicates you want to delete.

If you install a new version of a major package and you're interested in seeing how the executables have grown (they don't get smaller, do they?) and what new ones have been added, you might enter something like

```
CHKPATH /s=F:\WP50 G:\WP51 /a /p
```

You might also want to get a list of all executable files on your system, whether they're in your PATH or not. Assuming you have drives C: to G:, the simplest way to get this is

```
CHKPATH /d=C:-G: /a > ALLPROGS
```

This list has been redirected to a file to give you a permanent record—and because it's likely to contain more files than you'll want to look at simultaneously.

CHKPATH also allows you to compare information from more than one switch at a time. For example, if you enter

```
CHKPATH /d=c:-g: /a /s=path /n
```

the resulting list will be a record of all .EXE, .COM, and .BAT files on your PATH *and* all such files on drives C: through G:. A portion of such a listing

CHKPATH is useful for cleaning up potential problems along your DOS PATH.

(shown here with the /n switch, though in practice you would probably want a fully detailed presentation) might look something like this:

```
APPEND  C:\DOS\APPEND.EXE
         D:\UTIL\APPEND.BAT
        -D:\UTIL\OLD\APPEND.BAT
        -F:\TEMP\APPEND.BAT
```

This shows that entering APPEND at the DOS prompt will run C:\DOS\APPEND.EXE unless you start in one of the other subdirectories. The space to the left of the first two entries indicates that they are both in *specified* directories. In this case, the directories specified are those contained in the PATH environment variable. The minus sign to the left of the third and fourth entries means they are not in any of the specified directories, but were located in the /d=C:-G: drive sequence.

If you were to omit the added PATH variable and simply enter

```
CHKPATH /d=c:-g: /a
```

the list of files would be the same, but the minus signs would disappear. This is because CHKPATH prints the minus signs

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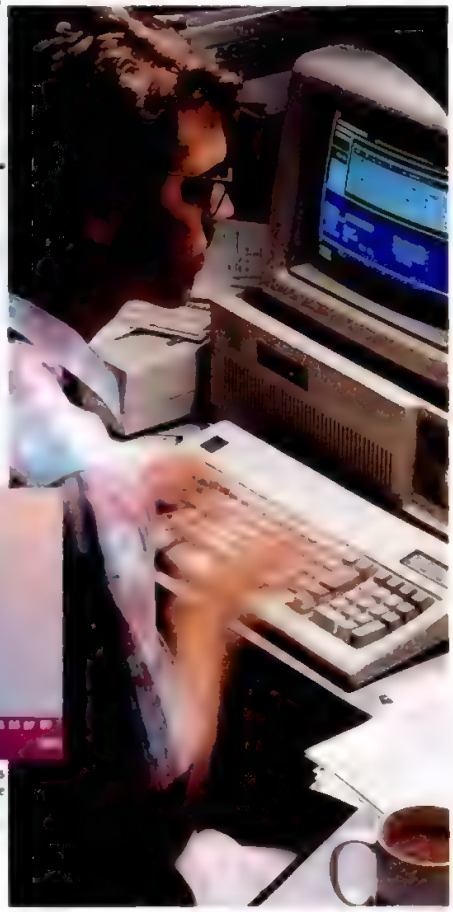

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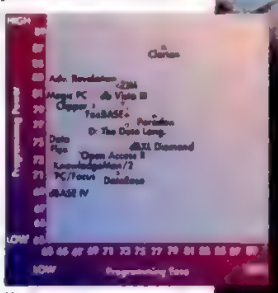

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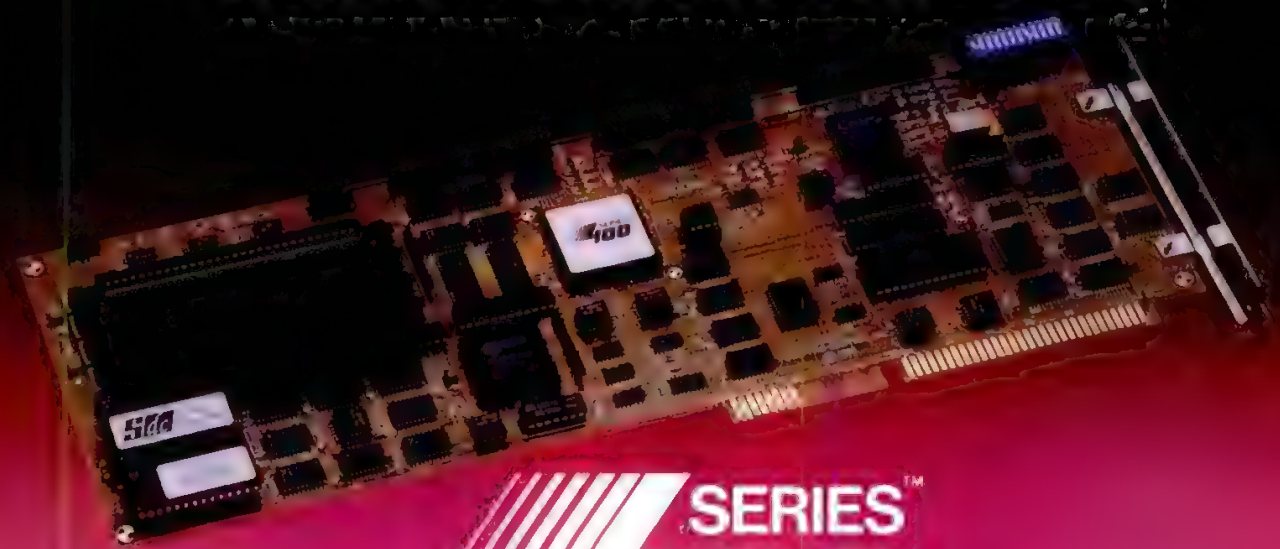

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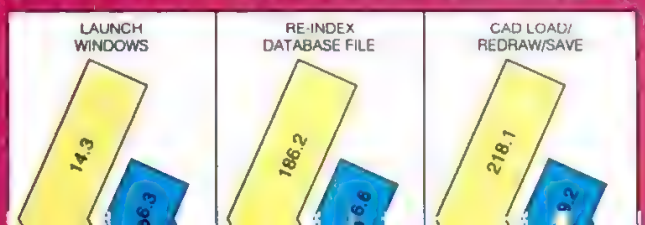

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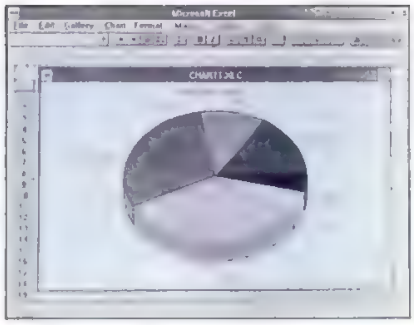

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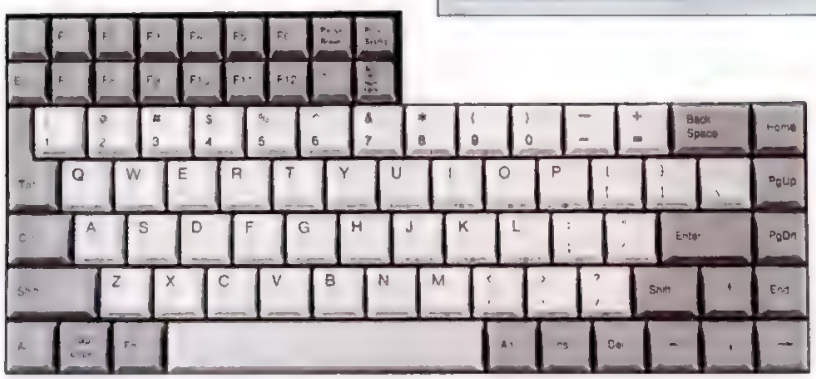

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next to unspecified directories only when both specified and unspecified directories exist. This makes the printed listing much more visually appealing.

Remember that if you specify any directories and omit the /a switch from the command line, CHKPATH will only print out the names of conflicting programs. So if you don't care about nonPATH programs that conflict with each other, just specify the DOS PATH.

A valuable use for this utility is to put it to work whenever you add a program or application to your system. If you install a new program in C:\NEWGUY and want to see how it fits in with the rest of your PATH before you add it in, you can check easily with the following line:

```
CHKPATH /e=path /s=C:\NEWGUY
```

Although CHKPATH is not a utility that you will use every day, when you want a list of the programs on your disk or you want to clean up potential problems along your DOS PATH, you should find CHKPATH useful.

PROGRAMMERS' NOTES

Written in Borland's Turbo C dialect, the CHKPATH code contains some conditional compilation statements and #defines so that it can also be compiled with Microsoft C or Quick C. (Specifically, the code has been tested with Turbo C++, Version 1.01 (in C mode), Borland C++, Version 2.0 (in C mode), Zortech C++, Version 2.18 (in C mode), Microsoft C, Version 6.00A, and Quick C, Version 2.51.) The distribution version of the executable file is the Microsoft C version (because it is smallest), and it has been further compacted with LZEXE.

Two files make up the source for CHKPATH: CHKPATH.C and EXITS.H. EXITS.H is #included into CHKPATH.C twice. This mechanism allows you to reorder and modify the various error messages and return values while easily keeping them in sync. It works rather simply. We invent a macro, EXITS, that takes two parameters. The first parameter is the name of a condition, and the second parameter is the string to be displayed when the condition is encountered.

The macro is invoked a number of times in EXITS.H. When we want to make a typedef that can index into an array of pointers to character strings, we build the typedef with the first argument to the macro, and the array of pointers to char with the second argument. This part of the code is shown in Figure 1a. The C preprocessor converts this, so that to the rest of the compiler, it looks exactly as if the code were that of Figure 1b. The nice thing about this construction is that it lets you keep all of your error explanation strings in one place. Also, it simplifies keeping your symbolic representation of error conditions (ERROR_USAGE, and so on) coordinated with the user messages.

> Most people will use CHKPATH, then leave it alone until it's time to add another program or find a problem.

A programmer must often choose between two strategies: save time or save memory. CHKPATH is not an everyday, all-day workhorse utility. Most people will use it, then leave it alone until it's time to add another program to their system or find a problem. Thus, I decided that when I had to make a choice between speed and reducing memory requirements, I'd slow down and be able to handle more files. This strategy has been effective. I have an 80MB hard disk with about 500 programs on it, and the data I collect takes up less than 20K of RAM. At that rate, my 640K machine should be able to collect complete information on a 1GB drive! In any case, that's why the downloadable version of CHKPATH uses the large model. In fact, since the program is so I/O-bound (it's waiting for DOS most of the time), switching to a large model costs very little (less than 4 percent) in terms of execution time.

EXITS.H — PARTIAL LISTING

```
(a)

    EXITS.H
        EXITS(ERROR_SUCCESS,"Operation successful.  Shutting down.")
        EXITS(ERROR_USAGE,  "Incorrect command line.")

    CHKPATH.C
        char *aacErrorArray[]={
            #ifdef EXITS
                #undef EXITS
            #endif
            #define EXITS(name,string) {string},
            #include"exits.h"
            {""}
        };
        typedef enum{
            #ifdef EXITS
                #undef EXITS
            #endif
            #define EXITS(name,string) name,
            #include"exits.h"
            ERROR_ERROR____   /* ANSI allows no comma after last enum*/
        }exit_code;


(b)

    char *aacErrorArray[]={
        {"Operation successful.  Shutting down."},
        {"Incorrect command line."},
        {""}
    };
    typedef enum{
        ERROR_SUCCESS,
        ERROR_USAGE,
        ERROR_ERROR____
    }exit_code;
```

Figure 1: The EXITS macro is used repeatedly in CHKPATH to display an output string upon encountering a condition. From the program's viewpoint, the code section shown in section a acts like that shown in section b.

PC MAGAZINE UTILITIES UPDATES

Like all good software, programs presented in *PC Magazine* are upgraded. You can get the modified versions by downloading them from PC MagNet. Here's a partial list of programs that have been upgraded to fix minor bugs and system incompatibilities:

ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.3
BCOPY, Version 1.2
BEN56.ARC (Benchmark Series, Version 5.6)
CHKFRAG.EXE, Version 1.2
CMDEDIT.EXE, Version 2.1
CONFIG.CTL, Version 3.0
DIRMATCH.COM, Version 2.0
EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
LASERLST.COM, Version 1.1
LITES.COM, Version 1.1
LOG.COM, Version 1.1
MONO.COM, Version 1.1
PANDORA.COM, Version 1.5a
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CHKPATH Command

John Deurbrouck June 11, 1991 (Utilities)

Purpose: Displays same-named .COM, .EXE, and .BAT files, or all files with these extensions, on the user's path or in specified drive(s) or directories; shows which program will be executed when the command name is typed; and warns of common problems in PATH syntax and usage.

Format:

```
CHKPATH [/a] [/d=drive(s)]
[/s=dir1 ... dirn][/e=var][/n] [/p]
```

Remarks: Entered without any of the optional / switches, CHKPATH presents a syntax help screen. The /a switch causes display of all program files rather than just conflicting-name programs. The /n eliminates file size, date, and time information from the list. The /p switch pauses at each screenful.

Using the /d= switch causes a search of all directories in the *drive(s)* named. No spaces between the drive letter colon and the next drive are allowed in this case, but sequential drives may be specified with a dash, as in /d=C:-F:H:. The /s= switch restricts the search to the directories specified, as in /s=C:\DOS D:\UTIL.

Most frequently, CHKPATH will be used with the /e= switch, with PATH as the specified *var*. By specifying /e=*var* more than once on the same CHKPATH run, however, conflicts among different directory-specifying environment variables may be checked at once. Environment variables should be formatted as in the DOS PATH statement.

CHKPATH will also alert you to the existence of empty, repeated, or relatively specified (backslash omitted) directories on the DOS path. More than one specifying switch can be used at once to make multiple-selection comparisons. When both specified and nonspecified directories are shown in the listing, the latter will be prefixed by a minus sign.

All CHKPATH output can be redirected to a printer or a file. Both the executable file and the C source code can be downloaded from PC MagNet.

The first thing to notice about the code is that you can easily produce a debugging version of the program. Such a version would print out which line of source code you were on when you called the EXIT macro. In addition, it would track and report memory usage. And finally, it would modify the EXIT macro to provide a mechanism for examining the situation that caused the exit to occur before all the data goes out of scope. See the EXIT macro, the trap() function, and the myquit() function in the source code for details.

The source code begins with some prefatory comments. Then, in sequence, come the #includes, the #defines, the structures, typedefs and enums, the global variables, the function prototypes, instructions for lint, and the function definitions.

The most complex functions include a block of pseudo-code designed to give an accessible view of what the function does. There are some in-line comments, and all functions have a standard-format header (machine extractable) that includes the function prototype and an explanation of what the function does.

Reading through main() will give you a good idea of the program structure. After showing the copyright, CHKPATH looks at each of the command line parameters in turn, setting switches or adding to a linked list of directories as it goes. Then, if the /d= parameter is present, it adds all of the nonpath directories to the linked list. If no directories are found to scan, it exits with an error message. Otherwise, it proceeds to scan all of the directories in the linked list. Since it has already filtered out nonexistent and repeated directories, it knows there aren't any duplications.

When the scan is complete, CHKPATH shows its results. Then, if no results were printed, CHKPATH prints out a message so that the user knows it didn't just die. Finally, it quits.

The add_nonpath_directories() function, which is called if the /d= parameter is present on the command line, is a simple function that cycles through all drives the user wants searched and tries to change to each of them. If the drive exists, it calls add_dir_and_recurse() to gather information on that drive. Not surprisingly, add_dir_and_recurse() is recursive, and this can be costly in terms of stack space. That's why buffer, its internal character array, is designated as static. This way, only one copy is present in memory, no matter how deep the recursion goes.

Since DOS will allow only about 66 characters in the PATH, the deepest stack penetration you could get—by assuming one-character directory names—is 33 deep. Each level uses up a character pointer (the parameter), a far return pointer (large model), and about 50 bytes of local variables. This comes to about 33×60 bytes, for our purposes, or total stack usage of less than 2K. Since we force the stack to 8K, we should be safe.

The normalize_path_name() function is a bit unusual. The basic problem is that

> CHKPATH uses a programming technique that makes DOS the final arbiter of path specifications.

CHKPATH doesn't know what will be in the user's directory specifications. Any relative PATH will have to be sorted out. And to make sure it flags any duplications, it'll have to resolve nonsensical but legal constructions such as C:\UTIL\OLD and C:\UTIL\..\OLD.

Rather than trying to be ingenious at this point, I decided to let DOS do the dirty work. Instead of parsing all the strings myself (and then, in the case of any relative PATHs, combining them with the default directories), I decided simply to have CHKPATH change to the specified drive and change to the specified directory, and then get the normalized, qualified pathname from DOS. Then all it has to do is change back to the previous default directory and change back to the previously current drive.

While this technique is not the fastest conceivable, DOS is the final arbiter of path specifications, and this way I know for sure that CHKPATH will get the same answer DOS does. Besides, this function is called only once for every directory (not once for every program name), so it's not likely to slow things down very much. Note also that no disk accesses are involved: DOS simply examines its own RAM-based information about each drive to perform the transformation.

Two linked lists are maintained by CHKPATH. One is a list of dir_q structures. The other is either a list of prog_queue_struct (if we're not collecting date, time, and size information) or big_prog_queue_struct (if we are collecting the additional data) structures. The comments in the declaration of each and in the add_dir_queue() and add_prog_queue() or add_big_prog_queue() sections of the source code lay out the relationship between the two lists. I should point out that only one copy of the directory information is retained for each directory and that each program in a directory points to that same directory information. Further, each program name is stored only once. Thus, if you have a FORMAT.COM and a FORMAT.EXE, "FORMAT" will be stored only once. Also note that the extension is tokenized, using the EXE, COM, and BAT #defines. This helps minimize the storage required.

This brings us naturally to malloc_nofree(). The usual malloc() is a great way to allocate memory dynamically. In this program, however, we're constantly allocating 1 to 20 bytes of memory at a time. In such a situation, malloc() can easily eat up half of the storage with its own housekeeping information.

Since CHKPATH doesn't need to free any of these tiny blocks individually, it has malloc_nofree() to serve as an intermediary between it and malloc(). It just calls malloc_nofree() as it would malloc(), and this function returns little bits of memory as they are needed. This means calling malloc() itself much less frequently, and with much larger requests. That saves a significant amount of space and is also faster than calling malloc() directly.

Why are there two essentially similar collection functions, prog_queue and big_prog_queue()? I decided that it was easier to write readable code by separating the two cases out. There are ways of getting the two together, reducing code size, and possibly increasing speed marginally. This method was easier to develop and debug. Besides, it should be easier for you (and me, next year) to read. ■

John Deurbrouck, a C and 80x86 assembly programmer, works on PC platforms in Mountlake Terrace, Washington.

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PC MagNet News

The Latest Files and Features of PC Magazine's On-line Service

LHA, Version 2.11, Hits PC MagNet

LHA (also known as LHarc), the very popular compression utility, has recently been updated and is now available on PC MagNet. With new Version 2.11, author Haruyasu Yoshizaki has increased LHA's compression rate in larger files, while increasing the speed of decompression notably over that of Version 1.13.

While the ability to create your own self-extracting archives remains a significant feature of LHA, its most attractive feature has to be the price. LHA is distributed as a *free* program, with copyright reserved, over our PC MagNet on-line service.

You can find LHA211.EXE in its own self-extracting archive, in DL 8, Gen Utils, of our UtilForum. On-line assistance concerning LHA is available from K. Okubu at 74100, 2565, CIS Mail.

Enjoy Windows Blackout

Although *Windows* 3.0 has quickly become the operating system of choice for many of today's personal computer users, there is without doubt a scarcity in leisure-time uses for the multitasking environment. PC MagNet thus brings you *Blackout*.

Blackout is a reflex action game written by Patrick Mills for *Windows* 3.0. The game has the exciting, fast-paced action that Solitaire notably lacks. Hand-eye coordination, mouse control, and challenging concentration demands all make this professional-looking shareware ($12) game worth its small price.

It runs on any *Windows* setup but is best on a VGA or Super VGA. It also requires a mouse or other pointing device. Version 2.0 of *Blackout* (BLACKO.ZIP) is available in DL 10, *Windows*, of PC MagNet's UtilForum.

AfterHours with Jesse Liberty

Jesse Liberty is chief sysop of PC MagNet's AfterHours Forum, where he provokes and shepherds most of the noncomputing topics discussed. He is also president of the Liberty Consulting Group, specializing in C programming and design for DOS and Unix environments. Jesse has been involved with computers for six years and has designed and programmed an interactive bulletin board, mail, discussion, and library system for teachers that is in use at PBS stations nationwide. He has operated a variety of bulletin boards and electronic services.

Jesse's consulting group includes his wife, Stacey Liberty, who specializes in word processing, typesetting, and human-interface design, and his 18-month-old daughter, Robin Liberty, who specializes in growing up.

Jesse is a former VP at Citibank where he worked in the Electronic Development division, and he's a former psychiatric social worker—bringing the right mix of computers, human concerns, and a touch of lunacy to After Hours. He sees his role there as a mix of facilitator and agent provocateur.

—Chris Parker

- **UPDATE ANNOUNCEMENT:** LHA, Version 2.11, is now available in UtilForum.
- **FUN AND GAMES:** *Blackout* provides fast-paced *Windows* excitement.
- **SYSOP PROFILE:** Jesse Liberty brings experience and fun to AfterHours.

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CIRCLE 304 ON READER SERVICE CARD

by
Charles Petzold

Environments

Bitmap Creation Under Windows: The Old Functions

The *bitmap* is fundamentally antagonistic to device-independent graphics programming. First, bitmaps cannot be displayed on nonraster output devices like plotters. Second, bitmaps often imply a particular size and device resolution. They can lose information when compressed or develop "jaggies" when expanded. Third, and perhaps most critical, particular output devices may not be capable of accurately rendering all the colors in a bitmapped image.

Yet bitmaps have become so important to the integration of real-world images into computer applications that we simply can't do without them. Instead, we must find some way to deal with these problems.

The only type of bitmap that is independent of output-device color capabilities is the monochrome bitmap, with 1 bit defining 1 pixel. But man does not live by monochrome bitmaps alone. Although dithering and halftoning can be implemented in monochrome bitmaps, this results in a loss of spatial resolution.

Color bitmaps require multiple bits per pixel. In versions of *Windows* prior to 3.0, color bitmaps were very much specific to particular output devices. For example, a 16-color bitmap could not be displayed on a 256-color device, and vice versa. Also, these early versions of *Windows* did not have a palette manager, so you were stuck with whatever colors the device driver selected.

The device-independent bitmap (DIB), introduced in *Windows* 3.0, solves these color problems—but only in part. It's important to understand both the limitations of the DIB and how *Windows* uses the color information contained in the DIB specification.

As I mentioned in the last issue, the word *bitmap* itself causes a problem when you're working with *Windows* 3.0, because a bitmap in *Windows* can really exist as three separate entities: A bitmap *file* is stored on-disk, a bitmap *specification* (basically the same information as a bitmap file) is stored in application memory, and a bitmap *object* is stored in memory controlled by *Windows* and referenced by a handle to the bitmap. You can have a device-independent bitmap file and a device-independent bitmap specification, but all bitmap objects are device-specific.

> ■ For many common uses of bitmaps, *Windows* 3.0's CreateDIBitmap function is not only more difficult to use, it doesn't give you any advantage over the old functions.

When I use the word *bitmap* by itself, I'll be referring to a bitmap object referenced by the bitmap handle.

CHECKING FOR BITMAP SUPPORT

Before we get too far, let's take care of the problem of nonraster devices such as plotters. The things I'll be discussing in this series on bitmaps are applicable only to raster devices—they can't be used with nonraster devices.

To determine whether a particular output device supports bitmaps, you call GetDeviceCaps with the RASTERCAPS parameter. The function returns a series of bit flags encoded in a 16-bit integer. Most of these flags are for internal use by *Windows* to determine the capabilities of the device driver. If the device driver does not directly support a particular operation, the *Windows* GDI module emulates it. However, two of these flags are also important to *Windows* applications. When discussing the *Windows* 3.0 palette manager, I showed how to test for palette support using the RC_PALETTE bit flag.

To test for bitmap support, you use the RC_BITBLT bit flag. If the expression:

```
RC_BITBLT & GetDeviceCaps (hdc,
 RASTERCAPS) ;
```

is nonzero, the device supports bitmaps and other raster functions (such as SetPixel and FloodFill).

You don't need to perform this test for video displays; *Windows* requires that they support bitmaps. But it's a good idea to make this test for printers, because the printer may actually be a plotter.

VIDEO MEMORY FORMATS

For the moment, let's focus on video displays. As I mentioned, bitmap objects in *Windows* (other than monochrome bitmaps) are always device-specific. What this means is that *Windows* stores the bitmap in memory in a format based on the organization of memory on a particular video display board. This allows maximum performance in rendering the bitmap on the video display.

Thus, to understand bitmaps, you must also understand how memory is organized on video display boards.

A monochrome graphics video board uses 1 bit per pixel. Generally, the memory on a monochrome video board (such as the CGA and the Hercules Graphics Card, both of which unfortunately are still in

Figure 1: In a monochrome graphics adapter board, each bit corresponds to one pixel.

common use) is organized as shown in Figure 1. Each byte contains 8 bits corresponding to 8 pixels. A 0 bit is black and a 1 bit is white. The most significant bits in each byte are the leftmost pixels. The video memory is usually organized sequentially, beginning with the top row on the display and continuing down.

A 16-color graphics video board requires 4 bits per pixel, and a reasonable way to organize such memory is shown in Figure 2. Each byte represents 2 pixels.

But memory on 16-color video boards such as the EGA and VGA (used in resolutions required by *Windows*) is *not* organized as shown in Figure 2. Instead, the memory is arranged in four *color planes*, and each plane is organized like the memory in a monochrome video board with 8 pixels per byte, as shown in Figure 3. Using four planes yields 4 bits per pixel for the 16 colors.

With 256-color video boards like the 8514/A and some Super VGA adapters, memory organization becomes more rational, as shown in Figure 4. Each byte contains 8 color-bits that make up a single pixel.

I don't have any hands-on experience with 24-bit color video boards (yet), but it's quite likely that some of them combine the color bits and the planar approach. Each of the red, green, and blue planes may be organized as shown in Figure 4. The combination of the three planes gives 24 bits per pixel.

A *Windows* program can determine how memory is organized by calling GetDeviceCaps with the BITSPIXEL and PLANES parameters:

```
iBitCount = GetDeviceCaps (hdc,
  BITSPIXEL) ;
iPlanes = GetDeviceCaps (hdc,
  PLANES) ;
```

For a monochrome board, these two values are both 1. For the EGA and VGA running under *Windows*, these values are 1 and 4, respectively. And for the 8514/A and 256-color Super VGA adapters, the two values are 8 and 1, respectively.

The total number of colors that the video display can render simultaneously can be calculated by the C expression

```
1L << (iBitCount * iPlanes)
```

Just like video displays, bitmap objects in *Windows* have a particular number of color bits per pixel and a particular number of color planes.

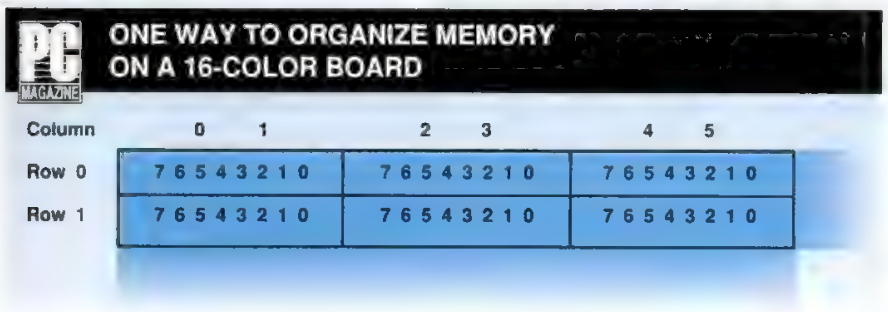


Figure 2: In a 16-color video board, each byte corresponds to two pixels.

THE OLD VS. THE NEW

Versions of *Windows* prior to 3.0 supported four functions that applications could use to create a bitmap object. These four functions are still supported under *Windows* 3.0; a fifth function named CreateDIBitmap is also available.

You may hear that some folks at Microsoft now discourage the use of the old functions to create bitmaps—they point you to the CreateDIBitmap function instead.

Indeed, you can do virtually everything you want with bitmap creation using CreateDIBitmap. This function is like an intelligent superset of the earlier bitmap functions. Despite its name, it doesn't create a new and different type of bitmap—it creates the same device-specific bitmap as the old functions, but in a different way. The more important implication of the new device-independent bitmap is its file format and the related bitmap specification.

Despite its name, CreateDIBitmap doesn't create a new and different type of bitmap—it creates the same device-specific bitmap as the old functions, but in a different way.

But don't get hung up about using CreateDIBitmap rather than the old bitmap-creation functions. For many common uses of bitmaps, CreateDIBitmap is not only more difficult to use, but it doesn't give you any advantage over the old functions. All the bitmap-creation functions are closely intertwined, as I'll demonstrate in this series.

If you're going to use a bitmap to capture part or all of the image on a video

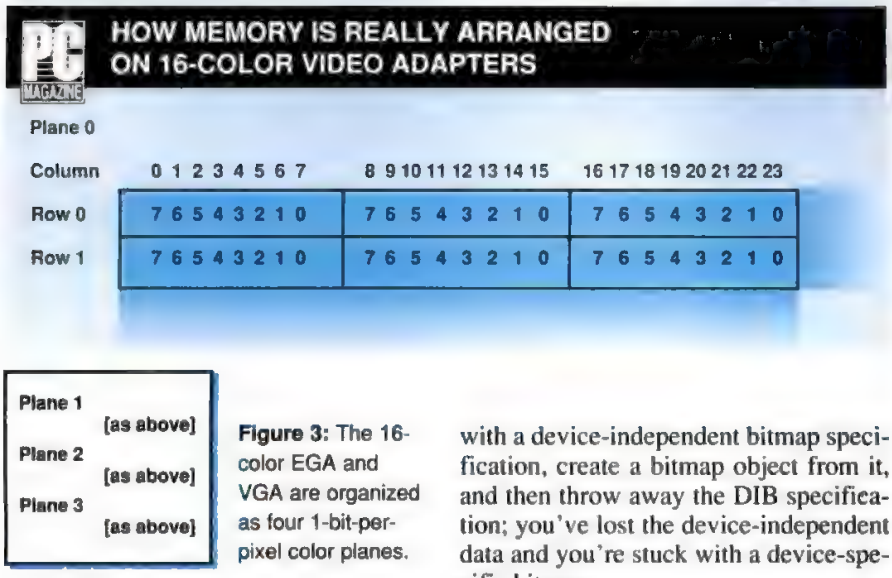


Figure 3: The 16-color EGA and VGA are organized as four 1-bit-per-pixel color planes.

display, you'll find using the old bitmap-creation functions easier. If you want to create a "shadow bitmap" for drawing on, using GDI functions to eventually transfer to the video display, again you'll find the old bitmap-creation functions easier to use. Even if you plan to save a bitmap as a file in the device-independent format (discussed in the last issue), you can still create the bitmap using the old bitmap functions.

Of course, there are some occasions when you'll want to create a bitmap using CreatDIBitmap rather than the old functions: when reading a device-independent bitmap file from the disk and displaying it on the video display, after obtaining a device-independent bitmap specification through the clipboard, or when creating bitmap images with specific color information.

But there are times when you may think you need to create a bitmap when there is actually no reason to! If you start with a device-independent bitmap specification, create a bitmap object from it, and then throw away the DIB specification; you've lost the device-independent data and you're stuck with a device-specific bitmap.

The most important lesson to learn from these columns on bitmaps is what to do in each situation.

THE MEMORY DISPLAY CONTEXT

It's almost impossible to discuss bitmaps in *Windows* without also discussing the *memory device context*. You need the memory device context to draw on a bitmap using the Graphics Device Interface (GDI) drawing functions and to transfer the image on the bitmap to the screen or a printer.

Normally, a *device context* refers to a particular graphics output device (such as a video display or a plotter) and its *Windows* device driver. A memory device context exists only in memory. It's not a real graphics output device, but it is said to be "compatible" with a particular real device.

For example, suppose that the variable **hdc** is a device context handle for a window on the video display. You can create a memory device context using the following call:

```
HDC hdcMem ;
....
hdcMem = CreateCompatibleDC
  (hdc) ;
```

This memory device context is said to be compatible with the video display. We'll see the implications of this "compatibility" shortly.

The memory device context has a display surface just like a real raster device. However, this display surface is initially very small–it's monochrome, 1 pixel wide and 1 pixel high. The display surface is just a single bit. You can't do much with a 1-bit display surface, so the only practical step to take next is to make the display surface larger. You do this by selecting a bitmap into the memory display context. Let's suppose **hbm** is a handle to a bitmap object (never mind where it came from for the moment). You select the bitmap into a memory device context like so:

> The bitmap you select in a memory device context must be either a monochrome bitmap or a bitmap with the same organization as the real device that the memory device context is compatible with.

```
SelectObject (hdcMem, hbm) ;
```

This is the same function you use for selecting pens, brushes, fonts, regions, and palettes into device contexts. However, the memory device context is the only type of device context you can select a bitmap into.

After the SelectObject call, the bitmap *is* the display surface of the memory device context, and you can do almost anything with this memory device context that you

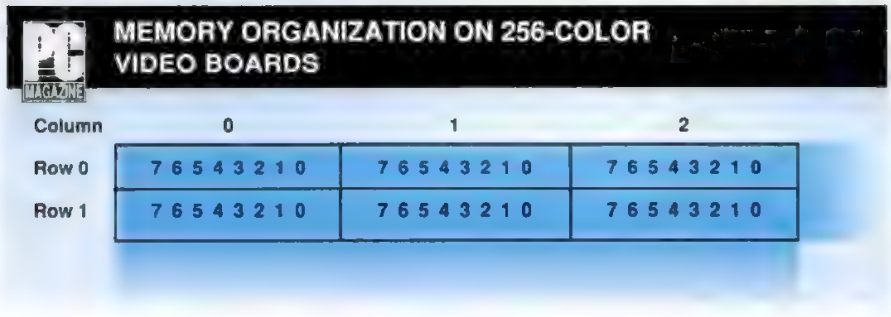


Figure 4: In 256-color boards, each byte corresponds to one pixel.

can do with a real device context. If you use GDI functions to draw on the display surface, the images you draw are drawn on the bitmap. You can use the BitBlt function to transfer a screen image into the bitmap, or to transfer the image in the bitmap to the video display.

Here's the catch: The bitmap you select in a memory device context must be either a monochrome bitmap or a bitmap with the same memory organization as the real device that the memory device context is compatible with.

For example, suppose your *Windows* program is running on a 16-color VGA. Memory on the VGA board is organized in four planes, where each plane has 1 bit per pixel. If you create a memory device context compatible with the video display, you can select only a monochrome bitmap into it, or a bitmap organized in four planes with 1 bit per pixel. Considering that you can't really do very much with a bitmap object without selecting it into a memory device context, this severely limits the formats of bitmap objects that your program can create.

BASIC WINDOWS BITMAP CREATION

Now let's begin looking at the four bitmap-creation functions supported under versions of *Windows* prior to 3.0. For all these functions, you'll first define a variable of type HBITMAP (handle to a bitmap):

```
HBITMAP hbm ;
```

The basic function to create a bitmap object is

```
hbm = CreateBitmap (iWidth,
  iHeight, bPlanes, bBitCount,
  lpBits) ;
```

The first two parameters are integer values specifying the width and height of the bitmap in pixels. The second two parameters are byte values with the number of color planes and color bits per pixel. The last parameter is a far pointer to an array of bits to initialize the bitmap image. This parameter can be NULL, to create an uninitialized bitmap.

You can set **bPlanes** and **bBitCount** to whatever you want, and GDI will create a bitmap for you. However, as I said, you can't do very much with a bitmap object without selecting it into a memory device context, and a memory device context is always compatible with a particular real device. The bitmap you select into the memory device context must be either monochrome or in the same format as the real device. If it isn't, SelectObject will return NULL, indicating an error.

In practice, you'll find that this limits you to just two choices: You can set **bPlanes** and **bBitCount** to 1 to create a monochrome bitmap and select this bitmap into any memory device context without error.

> You can't do much with a bitmap object without selecting it into a memory device context, which is always compatible with a particular real device.

Otherwise, **bPlanes** and **bBitCount** *must* be set to the values you obtain from GetDeviceCaps, using the PLANES and BITSPIXEL parameters for a real device context, and you can select this bitmap only into a memory device context compatible with this real device.

The CreateBitmapIndirect function is similar to CreateBitmap:

```
hbm = CreateBitmapIndirct   (&bm) ;
```

where the single parameter is a pointer to a structure of the type BITMAP, defined in WINDOWS.H as follows:

```
typedef struct tagBITMAP
    {
     int    bmType ;
     int    bmWidth ;
     int    bmHeight ;
     int    bmWidthBytes ;
     BYTE   bmPlanes ;
     BYTE   bmBitsPixel ;
     LPSTR  bmBits ;
    }
    BITMAP ;
```

As you can see, these fields are mostly the same as the five parameters to CreateBitmap, with two exceptions: the **bmType** field (which you set to 0, so it doesn't really matter) and the **bmWidthBytes** field, which indicates the width of each row of pixels in bytes. This must be an even number. Assuming the variable **bm** is a structure of the type BITMAP, you can calculate this field with

```
bm.bmWidthBytes = 2  * ((bm.bmWidth
  * bm.bmBitsPixel + 15) / 16) ;
```

The last field in the BITMAP structure is a pointer to an array of bits to initialize the image in the bitmap. (This can be set to NULL to create an uninitialized bitmap.)

To initialize the bitmap, you must know the format of the bitmapped data. In a monochrome bitmap, the format is fairly simple: The bitmap is organized by rows, beginning with the top row. Each row of pixels contains an even number of bytes. The most significant bits of the first byte contain the leftmost pixels of the row. A 0 bit is black and a 1 bit is white. If the pixel width of the bitmap is not a multiple of 16, the row must be right-padded so it has an even number of bytes.

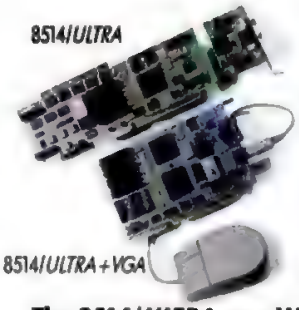
Suppose you want to create a 16-by-16-pixel bitmap initialized as a black background with a diagonal white line from upper left to lower right. The array of bits would be

```
BYTE abBits[] = {
    0x80, 0x00, 0x40, 0x00,
    0x20, 0x00, 0x10, 0x00,
    0x08, 0x00, 0x04, 0x00,
    0x02, 0x00, 0x01, 0x00,
    0x00, 0x80, 0x00, 0x40,
    0x00, 0x20, 0x00, 0x10,
    0x00, 0x08, 0x00, 0x04,
    0x00, 0x02, 0x00, 0x01 } ;
```

The format of bitmapped data in a color bitmap is . . . well, you really can't know. You can figure it out for common video adapters (and indeed, I'll be discussing these color bitmap formats in a future column), but doing so threatens your program with device-dependence and possible obsolescence.

This is why there was a need for something better in *Windows* 3.0, and that something is the device-independent bitmap. If you need to initialize a color bitmap, you'll want to use CreateDIBitmap or SetDIBits, which I'll discuss in the next issue.

A list of all the things you can do waiting for ATI's new 8514/*ULTRA* to open Windows.



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TWO MORE FUNCTIONS

As I mentioned, in practice you'll probably create only monochrome bitmaps or color bitmaps compatible with a particular device. For these color bitmaps, *Windows* supplies a simpler alternative to CreateBitmap:

```
hbm = CreateCompatibleBitmap (hdc,
  iWidth, iHeight) ;
```

This function creates a bitmap of the specified pixel width and height with a number of planes and color bits equal to the real device context whose handle is **hdc**. The function uses this handle only to obtain information about the memory organization of the device context. The CreateCompatibleBitmap function is equivalent to the following code:

```
bPlanes = (BYTE) GetDeviceCaps
  ( hdc, PLANES) ;
bBitCount = (BYTE) GetDeviceCaps
  (hdc, BITSPIXEL) ;
hbm = CreateBitmap (iWidth,
  iHeight, bPlanes, bBitCount,
  NULL) ;
```

Notice that you can't initialize the bitmap using CreateCompatibleBitmap. However, initializing color bitmaps using the old bitmap functions is not recommended.

We can now formulate some guidelines for creating bitmaps, based on two criteria: Use the simplest function possible and avoid device dependence. Here are the guidelines:

- For creating monochrome bitmaps (either initialized or uninitialized), use CreateBitmap.
- For creating uninitialized color bitmaps compatible with an output device, use CreateCompatibleBitmap.
- For creating initialized color bitmaps, use CreateDIBitmap.

Now I ask you: Are these or are these not the simplest *Windows* programming guidelines you've ever seen?

The fourth pre-*Windows* 3.0 bitmap creation function is

```
hbm = CreateDiscardableBitmap
  (hdc, iWidth, iHeight) ;
```

The parameters are the same as those for CreateCompatibleBitmap. If a discardable bitmap is not selected in a memory device context, *Windows* is free to discard the bitmap when memory gets low. (Obviously, this function should be used only for bitmaps that can be easily regenerated.) If the bitmap is discarded and a program attempts to select it into a memory device context, the SelectObject function will return NULL. The program should then delete the bitmap handle by calling DeleteObject.

CreateDiscardableBitmap is much less important now than it was in the days when *Windows* didn't use protected mode. I haven't experimented with this myself, but I've heard that it's very difficult to persuade *Windows* 3.0 to discard a discardable bitmap. Under the forthcoming 32-bit version of *Windows*, *I* wouldn't be surprised to see this call become functionally equivalent to CreateCompatibleBitmap.

OTHER OLD BITMAP FUNCTIONS

If you create an uninitialized bitmap, you can still initialize it at a later time. To do this you use

```
SetBitmapBits (hbm, dwCount,
  lpBits) ;
```

where the second parameter is the number of bytes pointed to by the last parameter. You can also obtain the following bitmap bits:

```
GetBitmapBits (hbm, dwCount,
  lpBits) ;
```

where the last parameter points to an array that receives the bits. Because the format of color bitmap data is not available without device-specific snooping, use these functions only for monochrome bitmaps. For color bitmaps, use the device-independent equivalents (SetDIBits and GetDIBits) instead.

One exception to this rule is for making copies of bitmaps that are compatible with the same device. In this case, you can use GetBitmapBits on the original and SetBitmapBits on the copy. You don't need to know the format of the data to do this.

Do you know that *Windows* 1.0 had a 64K limit on the size of a bitmap? Getting rid of this limit was one of the enhancements of *Windows* 2.0. Still, you may be wondering about setting or getting bitmap data where the size exceeds 64K. Rest assured that the CreateBitmap, CreateBitmapIndirect, SetBitmapBits, and GetBitmapBits functions all support huge memory blocks. Just allocate the buffer, using GlobalAlloc with a size greater than 64K. However, if the bitmap is very large and you don't want to use that much memory at one time, use SetDIBits and GetDIBits instead. These functions allow setting or getting bitmap bits in smaller chunks.

To obtain the size and memory organization of a bitmap (possibly in preparation for calling SetBitmapBits or GetBitmapBits), you use

```
GetObject (hbm, sizeof (BITMAP),
  (LPSTR) &bm) ;
```

where **bm** is a structure of type BITMAP. Ignore the **bmBits** field. The total size of the bitmap data in bytes can be calculated by

```
(long) bm.bmWidthBytes *
  bm.bmHeight * bm.bmPlanes
```

To delete a bitmap, call

```
DeleteObject (hbm) ;
```

Don't delete a bitmap while it's selected in a memory device context.

To delete a memory device context, use the line:

```
DeleteDC (hdcMem) ;
```

You *can* delete a memory device context if a bitmap is selected into it. The bitmap will still be available.

There's a fifth pre–*Windows* 3.0 function that returns a handle to a bitmap. This is it:

```
hbm = LoadBitmap (hInstance,
  szName) ;
```

This function is used for loading a bitmap resource from a program's .EXE file, from a dynamic link library, or from one of the predefined bitmaps, such as those used for elements of the user interface (like the check marks on menu items).

With the exception of GetBitmapDimension and SetBitmapDimension (which have very little functionality and have probably rarely been used), we've now covered all of the pre–*Windows* 3.0 bitmap functions. In the next issue, I'll discuss the new bitmap functions introduced in *Windows* 3.0. ■

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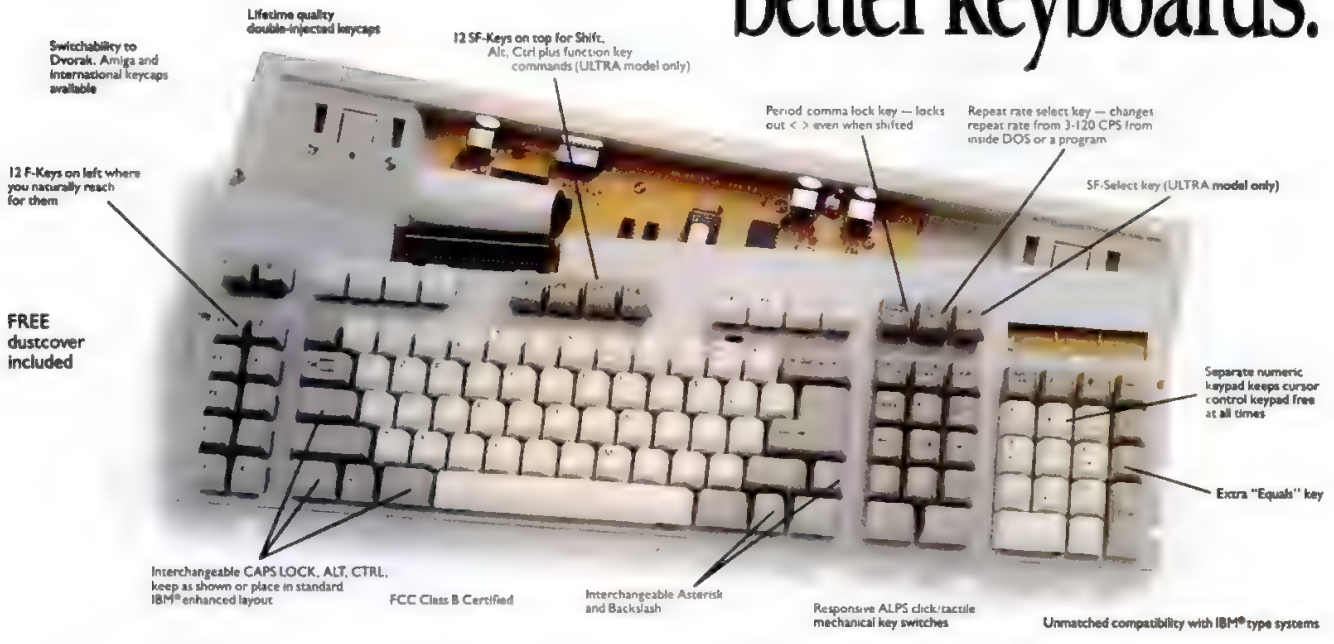

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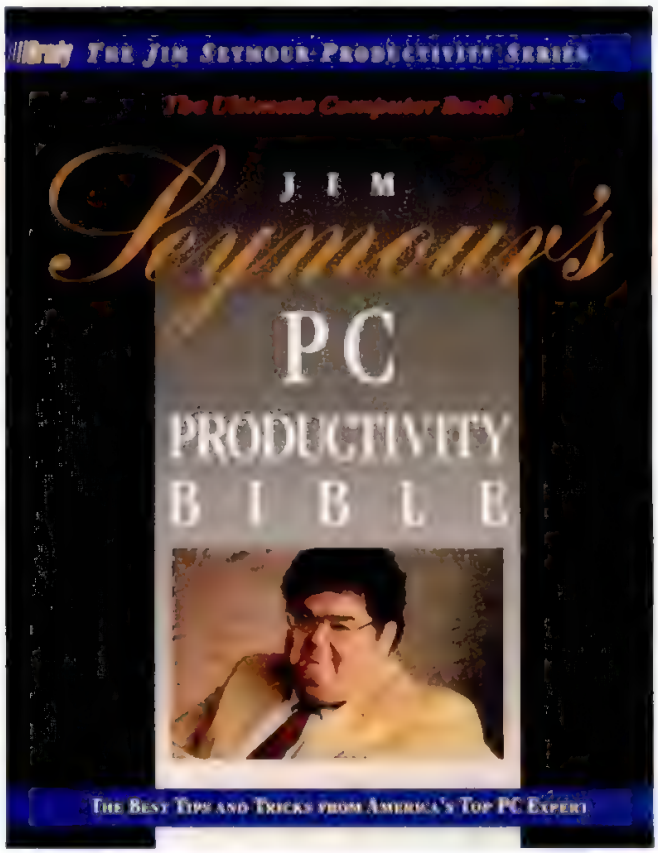

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CIRCLE 257 ON READER SERVICE CARD

by
Ray Duncan

Power Programming

Mastering the Complexity of the Windows API

The annual Software Development conference, sponsored by Miller-Freeman Publications, has become the premier event for serious programmers. The conference is always a great place to see and hear famous writers, theorists, and developers—ranging from Adele Goldberg to Stan Kelly-Bootle—but it's also a very useful barometer of trends in the industry. At the '88 and '89 conferences, many of the presentations dismissed DOS as a dead issue, and looked toward Unix and OS/2 as the development environments and application targets of the imminent future. But at SD '90, most speakers seemed resigned to the continued dominance of DOS and *Windows*, and the biggest news at the conference was Borland's announcement of a new version of C++ that can build *Windows* programs.

Those of you who are new to the *Windows* racket may well wonder why Microsoft C and the *Microsoft Windows* Software Development Kit have had such a hammerlock on the *Windows* development market for so long. After all, if the *Windows* function call interfaces are designed to be called directly from C, and *Windows* applications by definition use *Windows* system functions for all keyboard, mouse, and screen I/O instead of the C runtime library, one ought to be able to write a *Windows* program with any old C compiler, right?

This assumption, which seems eminently reasonable on the surface, turns out to be dead wrong for two reasons that are entirely unrelated to the C language itself: the macro-structure of *Windows* executable files, and certain support for *Windows'* virtual memory manager in the C compiler's code generator.

WINDOWS .EXE FILES

Before looking at the internals of *Windows* programs, let's consider the composition of the two types of programs recognized by plain-vanilla DOS. The simplest type is a .COM file; it consists of a pure code image without any file header, relocation table, or debugging information, and it's limited to a maximum size of 64K. The loader launches a .COM program by allocating the largest available block of free memory, building a program segment prefix (PSP) at the bottom of the block, reading the .COM file into memory just above the PSP, and jumping to the first byte of the program. Philosophically, .COM files are the direct counterparts of the executable program format used by Digital Research's CP/M operating system for 8080 and Z-80 microcomputers, and this heritage is all too evident in the lack of safeguards associated with such files. You can rename any data file with a .COM extension, type its name at the command line prompt, and DOS will cheerfully commit suicide by bringing the "program" into RAM, transferring control to it—and crashing horribly.

> ■ Until the advent of Borland's C++, Microsoft C and the *Microsoft Windows* Software Development Kit have had a hammerlock on the *Windows* development market.

The other, more-sophisticated type of DOS executable file is called an .EXE program. An .EXE file has three main components: a file header, a relocation table, and the program's code and data (see Figure 1). The header is not very complex and contains only a few important items of information: a 2-byte signature MZ (the initials of Mark Zbikowski, one of the principal authors of DOS, Versions 2.0 through 3.1); the sizes of the header, relocation table, and entire file; initial values for CS:IP and SS:SP at program start-up time; a CHECKSUM; and some memory-allocation guidelines for the DOS kernel's loader. There is no maximum size to an .EXE file, and debugging information that will be ignored by the DOS loader can be included by the simple expedient of appending the information to the end of the file without changing the file size stated in the file header.

DOS .EXE files are certainly a major improvement over .COM files; on the other hand, they aren't nearly as great in practice as they might first seem. The main reason is that .EXE files don't preserve any information about individual segments within a program; when the linker builds the .EXE file, it collects all the segments you declared in your source code into a single giant lump with a global relocation table. There's no way for the system loader to determine which part of the program is executable code, which part is static data (such as strings and numeric constants), and which part is variable data. Because of this, there's no possibility for the loader to allocate individual memory blocks to hold each of these components and manipulate the segments independently.

When Microsoft developers were cooking up *Windows* 1.0, they found the constraint of 640K of memory available in real mode under DOS to be so severe that elaborate

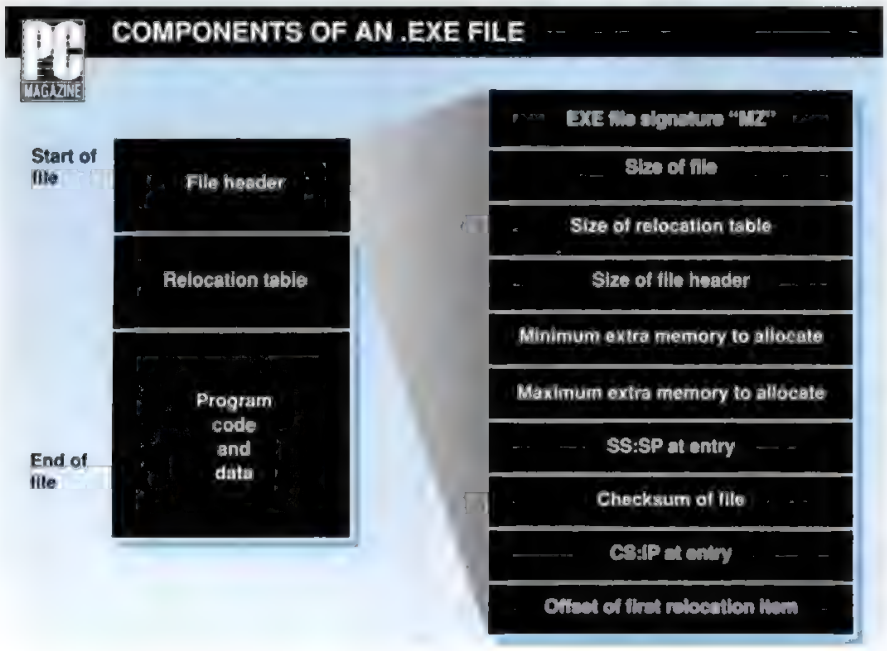

Figure 1: The three components of a DOS .EXE (old .EXE) file. The file has a simple structure consisting of a header, a relocation table, and an image of the program's code and data.

program segmentation was the only hope for making the system work at all. *Windows* had to be able to keep just enough of a particular program in memory to let the program make forward progress and discard or swap out the pieces of the application not currently in use. The *Windows* team's solution was to define a new structure for executable files, referred to as *segmented executable* or *New .EXE* files, and to build a loader for these files into *Windows* itself. When *Windows* is running, it intercepts calls by application programs to the DOS EXEC function (INT 21h function 4Bh) and handles the loading of both New .EXE and "Old .EXE" files appropriately.

The New .EXE format is a true superset of the DOS .EXE (or Old .EXE) format, and we can think about its structure at several levels of abstraction (Figure 2). At the highest level, a New .EXE file has two parts: an Old .EXE component and a New .EXE component. The Old .EXE portion holds a complete Old .EXE header, relocation table, and program; if a New .EXE file is by chance run from the DOS command line, the DOS loader recognizes the Old .EXE header and runs the Old .EXE program (in a *Windows* application, the Old .EXE program is usually very short—it just displays the message "This program requires Microsoft Windows" and exits). If the New .EXE file is run from the *Windows* Program Manager or File Manager, the Old .EXE portion of the file is ignored.

Turning to the New .EXE portion of the New .EXE file, we find that its elements fall into three distinctly different classes: The first group is composed of the New .EXE header and various tables that identify the size, location, and characteristics of everything else found in the file; they are used by the system loader and are invisible to the application itself when it is running. The second group is made up of the program's code and data segments, each with its own relocation table. The third group is made up of resources. A *resource* is a static chunk of data such as an icon, a cursor, a bitmap, a menu, or a collection of strings. Each resource in the file is identified by a name and a type, and it can be loaded into memory by the system at the application's request.

The New .EXE format has stood the test of time remarkably well and is a monument to the careful engineering and the foresight of the original *Windows* 1.0 developers. *Windows* 3.0, which is about as drastic an overhaul of the original *Windows* implementation as one can imagine, required only the definition of a single additional flag in the New .EXE header to indicate that an application is able to run in protected mode. The 16-bit versions of OS/2 and the latest wave of 16-bit DOS Extenders use a minor variant of the New .EXE file format as well.

There is still no utility that can manipulate New .EXE files in an efficient, straightforward manner—for example, to extract a single resource from an existing .EXE file, modify it, and put it back again—but perhaps the immense popularity of *Windows* 3.0 will cause some tools vendors to get busy in this area.

WINDOWS VIRTUAL MEMORY

Once the New .EXE file format was under control, the *Windows* 1.0 architects turned their attention to provision of virtual memory in real mode for *Windows* applications—in other words, the ability of *Windows* programs to use a logical address space larger than the amount of physical memory available. Since they were forced to implement this virtual memory without the benefit of hardware assistance, they based their virtual memory scheme upon nonpreemptive multitasking— in which an application yields control only at precisely defined points in its execution—and upon a complex set of conventions, interfaces, and on-the-fly code patching that would send shudders down the spine of any right-thinking computer scientist.

First, the *Windows* designers decreed that *Windows* applications could only be written using the memory models that have a single data segment: in other words, the small and medium models. If the application has need for more data than would fit into a single 64K segment, it is supposed to allocate additional memory from the *Windows* "global heap" at its runtime and initialize this memory (if necessary) by loading it from resources in its own .EXE file or from data stored in other files. This restriction allows the *Windows* kernel to move an application's data segment around with impunity after it is running, fixing up the application's DS register to match, because the application will never (theoretically, at least) have a reason to reload its DS behind the system's back.

Second, *Windows* applications were forbidden to use the normal DOS interface for allocating memory and were required instead to use a new memory management layer in the *Windows* kernel. When a program allocates a memory block with this interface, *Windows* returns a handle

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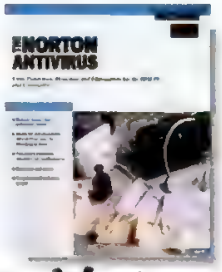

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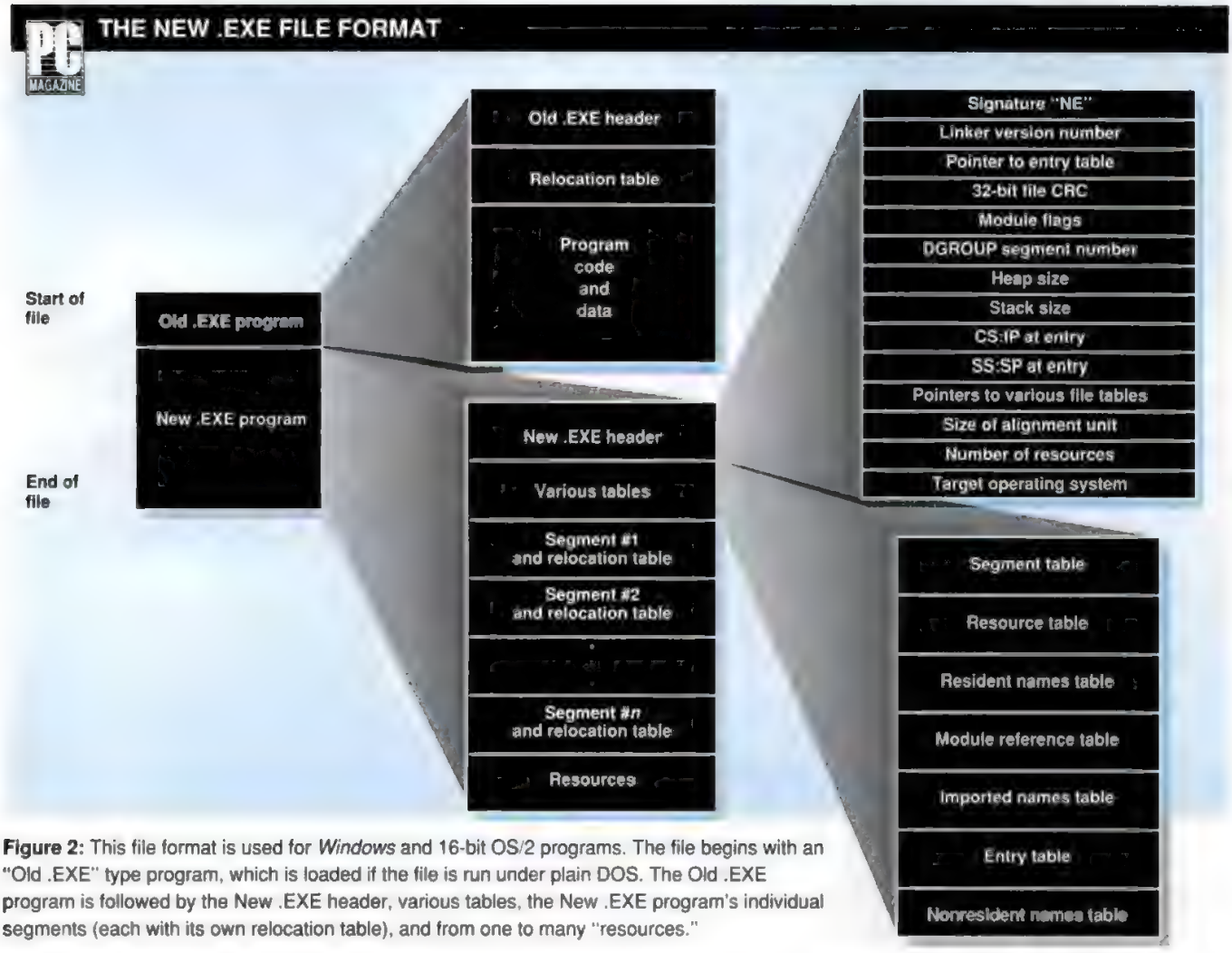

Figure 2: This file format is used for *Windows* and 16-bit OS/2 programs. The file begins with an "Old .EXE" type program, which is loaded if the file is run under plain DOS. The Old .EXE program is followed by the New .EXE header, various tables, the New .EXE program's individual segments (each with its own relocation table), and from one to many "resources."

rather than a specific physical address. At the time the application actually needs to access the memory, it makes an additional *Windows* function call to "lock" the memory block and obtain the block's current address. After inspecting or modifying the memory, the application is expected to "unlock" the block again as soon as possible so that *Windows* can move it around or swap it out to disk as needed. This emulates, to some degree, the relationship between selectors, descriptors, and physical memory segments that exists when an 80286/386/486 is running in protected mode.

Third, the architects required that a *Windows* application register all of its procedures that are entered from the *Windows* kernel and are not window procedures (that is, procedures not associated with a *Windows* message queue) by calling the system function MakeProcInstance. This function creates a little fragment of code, called a *thunk*, that always serves as the initial target of the *Windows* far call to the application; the thunk loads AX with the address of the application's data segment and then jumps to the application entry point. When *Windows* relocates either the application's code or data segment, it can compensate for this by patching the MOV and JMP instructions in the thunk appropriately.

Fourth (and this is the most bizarre part of the *Windows* virtual memory scheme), the *Windows* designers required that all functions exported by a *Windows* program or library—functions whose entry points were made available to the *Windows* kernel or to other *Windows* applications for linking by name at runtime—should be compiled with special prolog and epilog sequences. As you're no doubt aware, the code that makes up a "normal" non-*Windows* C function is framed by the following prolog and epilog (or their equivalent):

```
push bp
mov  bp,sp
sub  sp,xxx
.
.
.
add  sp,xxx
pop  bp
ret
```

The standard C prolog sets up a stack frame, making the stack addressable via BP. The routine can then address parameters passed to it on the stack as positive offsets from BP, and local variables (allocated by the **sub sp,xxx** instruction) as negative offsets. In the epilog, the local variables are discarded by the **add**

sp, xxx instruction (or, sometimes, **mov sp, bp**), then the BP register is restored and the routine returns to its caller. Since the C language allows functions with variable numbers of parameters, ordinarily it's the caller's responsibility to clear the stack of a function's parameters. The prolog and epilog of an exported procedure in a *Windows* program are a lot more complicated:

```
push ds
pop  ax
nop
inc  bp
push bp
mov  bp,sp
sub  sp,xxx
push ds
mov  ds,ax
.
.
.
pop  ds
mov  sp,bp
pop  bp
dec  bp
ret  yyy
```

What odd code, eh? First, notice that the routine clears the stack of its parameters with the **ret** instruction, rather than relying on the caller to do it. This is part of the far pascal calling convention, which found favor with the original *Windows* developers (in spite of its un-C-like nature) because it saved several kilobytes of memory systemwide. Next, observe the mysterious increment of BP before that register is pushed. The explanation of this maneuver is truly arcane, and you may have to spend some time with a *Windows* debugger to convince yourself that it does in fact work. The condensed explanation is as follows:

The stack of a C application is composed of a series of stack frames, which reflect the exact state of the program: it was entered by a call to its **main()** procedure, which in turn called another procedure, and so on. Assume that an application's stack is always word aligned. Then, the pushed BP values can serve as far call flags. If the procedure is an internal or near procedure, it will have a standard C prolog, the pushed BP value (which is actually the frame pointer for the next outer procedure) will be even, and the value above it on the stack will be a near return address. If the procedure is entered by a far call and has the special *Windows* prolog, the pushed BP value will be odd, and the return address above it on the stack will be a far pointer.

Now for the magic! Each time the *Windows* kernel relocates a code segment, it retrieves the current value of each application's BP register and "walks" the application's stack from the innermost stack frame to the outermost, finding and updating any far pointers that referred to the code segment in question along the way. If the code segment was discarded instead of relocated, the return address is altered to point to a kernel routine that will reload the segment.

> The *Windows* virtual memory scheme is a tribute to the ingenuity of the human mind.

The last item of interest in the special *Windows* prolog is the apparently redundant copying of DS to AX and then back to DS. Strangely enough, if you use a debugger to peer at the prolog of an exported procedure in a *Windows* application that's actually loaded and running, you won't find the code listed above at all! Instead, you'll see the following:

```
nop
nop
nop
inc  bp
push bp
mov  bp,sp
sub  sp,xxx
push ds
mov  ds,ax
.
.
.
```

At compile time, it's only known that a function is entered by a far call, since functions are marked as exported (or not) during linking. Thus, the compiler generates this lengthy but harmless code that has no net effect on DS for all far procedures. The *Windows* loader patches the prolog of each exported function, changing the **push ds** and **pop ax** instructions to **nops** so that when the procedure is entered from a thunk with the address of the data segment in AX, the proper value will be moved to DS. Of course, almost none of this nonsense is really necessary when a *Windows* program is running in protected mode, but the whole load of baggage must be lugged around by the applications and *Windows* kernel anyway. The entire *Windows* virtual memory scheme is a tribute to the ingenuity of the human mind, a testament to the perversity of real mode, and a boondoggle that is apparently going to linger for many years to come. It certainly makes one nostalgic for the good old days of OS/2. But I digress.

MEANWHILE, BACK AT THE RANCH...

I began this column by mentioning that Borland C++, Version 2.0, is able to build *Windows* applications, marking the end of Microsoft's dominance of the *Windows* programming tool market. Reviews have raved (and justly so) about BC++'s new integrated development environment (IDE), replacement of obscure Make files with Project files, support for precompiled header files, inclusion of the VROOM overlay manager, ability to run in extended memory, and so on. But although BC++ 2.0 is truly an awesome software package and confirms Borland's emergence as the standard-setter for programming tools in both style and performance, you can now appreciate that the many nifty features of Borland C++ have essentially nothing to do with its ability to be used as a *Windows* development platform. All that was needed was the ability to compile the special *Windows* prologs and epilogs, a linker that could build New .EXE files, and clones of a few minor Microsoft tools such as the icon editor and resource compiler.

The question now is, Can C++ as a language live up to its promises and help us master the complexity of the *Windows* API? We'll look at some of the differences between C and C++ in the next installment of this column.

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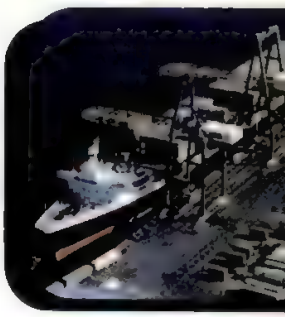

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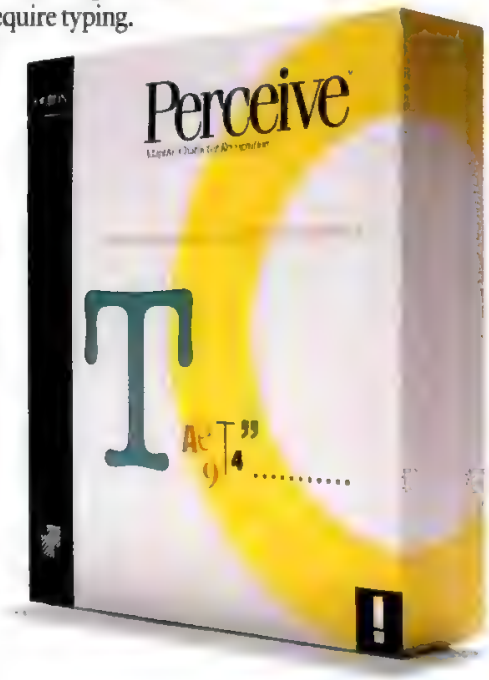

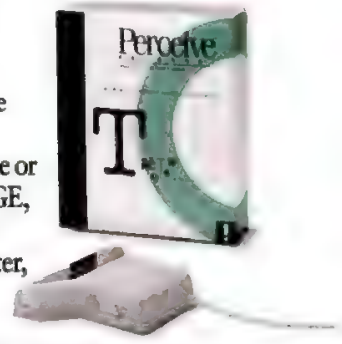

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by
Fran Finnegan

Windows

ORDERING PROGRAM GROUPS

Microsoft has assumed that the last program group you use is the first one you will want to use the next time you run *Windows* 3.0. As a result, the layout of the program groups in the Program Manager window is different every time you start up. This makes it necessary to read the subtitles for each group to find the one you want. If you keep the layout of the groups the same, you can click on the desired program group by location rather than by name.

How can you preserve the layout each time you start up? The answer is to create a version of PROGMAN.INI that is copied into the \WINDOWS subdirectory every time you run *Windows*. The process asks you to create the standardized program group arrangement and capture this arrangement in PROGMAN.INI. The steps are as follows:

First, arrange the program groups in the locations you want them. Enlarge the window and perform a Window Arrange Icons step so that no opened window will obscure any of the program group icons. Then, open each program group window, starting at the lower-left corner, working left to right and proceeding upwards one row at a time. Then close the windows in reverse order (the last one opened will be on top of the pile; close it first, and so on).

When all program groups are closed, restore the Program Manager window to its original size and perform another Window Arrange Icons step to restore the original layout of the Program Manager window. The next step cannot be done from within *Windows*, since it might necessitate opening up one of the program groups. That would upset the order of the groups now recorded in PROGMAN.INI. So exit *Windows* with the Save Changes box checked.

At the DOS prompt, copy the file PROGMAN.INI to another subdirectory, such as C:\WINDOWS\GROUP. This copy will then be used as a permanent record of the standardized way you want your Program Manager layout to look.

- **ORDERING PROGRAM GROUPS:** There are tips to investigate—and tricks to avoid—when you want to create a permanent landscape for your group icons.
- **A SNEAKY WINWORD START-UP TRICK:** *Windows* won't let you specify parameters when you load minimized programs. Here's a way to skirt that limitation.

To use this standardized file, start *Windows* with a batch file that copies PROGMAN.INI from the C:\WINDOWS\GROUP subdirectory back to the WINDOWS subdirectory. Then the batch file can start *Windows* with the WIN command at the appropriate subdirectory location. The batch file could look as follows:

```
c:
cd \windows\group
copy progman.ini ..
cd ..
win
```

When you make a change in the way you want the Program Manager window to look, you'll have to repeat this process.

Is there another way to accomplish the same task, short of using the Recorder? I would be interested to try other methods.

Don Robinson
Kent, Washington

PC MAGAZINE First, I'll make some observations about your procedure, which works but may be risky. Then I'll describe an alternative method.

The layout of your program groups in the Program Manager window has nothing to do with the *Windows* environment. It involves only the Program Manager, one of three shells that comes with *Windows* 3.0. The other two shells are the File Manager (WINFILE.EXE) and the MS-DOS Executive (MSDOS.EXE). Additional shells are available from other third-party vendors.

The shell that *Windows* starts after setting up the *Windows* environment is the one listed as **shell=** in the [boot] section of the SYSTEM.INI file; the default is **shell=progman.exe.** When *Windows* starts up the Program Manager (PROGMAN.EXE), the Program Manager reads its PROGMAN.INI file. A section in it named [Groups] determines the order in which the group windows are created when you start *Windows*. Individual group files (which end with the .GRP extension) hold the contents of the group and the location of the group window when it is opened. As each group window is created, it is "on top" of the previous group. The last group listed is the group that is active after Program Manager is finished initializing, because it was the last one created.

A SAMPLE [GROUPS] SECTION OF PROGMAN.INI

```
[Groups]
Group1=C:\WINDOWS\ ACCESSOR.GRP
Group2=C:\WINDOWS\GAMES.GRP
Group3=C:\WINDOWS\TOOLBOOK.GRP
Group4=C:\WINDOWS\SDK.GRP
Group5=C:\WINDOWS\TOOLS.GRP
Group6=C:\WINDOWS\WORDPROC.GRP
Group7=C:\WINDOWS\EXCEL.GRP
Group8=C:\WINDOWS\EMAILMAN.GRP
Group9=C:\WINDOWS\CD-ROM.GRP
Group10=C:\WINDOWS\COMM.GRP
Group11=C:\WINDOWS\DOS.GRP
Group12=C:\WINDOWS\MAIN.GRP
```

Figure 1: The iconized groups are listed first in left-to-right order, followed by the open window groups, with the active group (Main) listed last.

If you Ctrl+Tab to the next group, you will move to the next-to-last group in the list, and so on.

When you close Program Manager in order to exit *Windows*, you are presented with the Exit Windows dialog box. If the Save Changes check box is checked, the Program Manager will update the PROGMAN.INI file [Groups] section to reflect the order in which you used the groups. The least recently used group is saved as **Group1=** and the most recently used group is saved as the last entry in the list. If the Save Changes check box is *not* checked, the Program Manager will *not* update the PROGMAN.INI file [Groups] section to reflect the order in which you used the groups. So you really don't have to use a copy procedure as Robinson does to maintain your preferred order: Simply exit *Windows* once with Save Changes checked (so that your order is recorded) and exit *Windows* the next time and each subsequent time without Save Changes checked (so that you do not overwrite your preferred order).

However, if you still want to use your copy procedure, I definitely wouldn't waste disk space by creating a subdirectory to hold a copy of your original PROGMAN.INI file. Instead I'd just use a different filename, such as PROGMAN.OLD, and keep the file in the C:\WINDOWS subdirectory. Your batch file would then look like this:

```
c:
cd \windows
copy progman.old *.ini
win
```

But your copy procedure is still risky, because you may overwrite a new group that you or an application such as *Excel* 3.0 might later add to PROGMAN.INI. You might end up with a stranded .GRP file not listed in your PROGMAN.INI file. So I wouldn't use your copy procedure; I'd just never exit *Windows* with Save Changes checked.

An alternative method for ordering groups is to edit PROGMAN.INI directly, using Notepad or another text editor. The format of the [Groups] section (illustrated by the sample in Figure 1) is pretty straightforward. List the iconized groups first in the order that you want them to show up from left to right. Put the open-window groups at the end, with your initial active group window last.

A SNEAKY WINWORD START-UP TRICK

I like to preload a few of my applications when starting up *Windows* 3.0. As you may know, this is done by appending a list of program or data filenames (separated by spaces) to the **load=** entry in WIN.INI. The procedure works fine, until you need to append an optional parameter to the program name upon start-up. For example, I like to start *Microsoft Word for Windows without* opening the blank document window, document1. To do this, the WIN.INI entry might read

```
load=WINWORD.EXE /n
```

However, if you use this line, *Windows* interprets the /n as another program or data file to be loaded, and an error will result.

The way I've found to trick *Windows* into using optional parameters is by disguising them as a data filename. For example, the entry I use to start *Word for Windows* with the /n parameter is

```
load=/n.DOC
```

Windows interprets anything with a .DOC extension as a *Word for Windows* data file. Thus, it starts *Word for Windows* as though you typed the command line

```
WINWORD /n.DOC
```

When *Word for Windows* encounters the /n, the program interprets it as a parameter, not a filename, and starts without loading a file. Note that an actual file with the name /n.DOC is not necessary and is in fact impossible with standard DOS filename conventions.

Similar substitutions should work for most parameters. You can enter up to four parameters by placing them all in an eight-character filename. For example, /f/o/c/i.XXX. It's sneaky and against all DOS filename rules, but it does work.

Paul Papanek Stork
South Euclid, Ohio

This is a great trick. Not only does it work with **load=** in the WIN.INI [Windows] section, but it will also work with the section's **run=** entry.

The trick takes advantage of how *Windows* parses (in other words, breaks down) the fields of the **load=** and **run=** lines. It looks at the extension of a field to determine what to do. If it finds that the field ends in .COM, .EXE, .BAT, or .PIF (the extensions listed after **programs=** in the WIN.INI [Windows] section), it will attempt to find and load or run that program directly. For any other extensions, it looks in the [Extensions] section of WIN.INI. If it finds a matching entry there, it will load or run the program after the extension, and pass that program the entire field as listed on the **load=** or **run=** line. *Windows* doesn't even look to see whether the field is a valid filename. At that point, it's the application's responsibility to interpret the field passed to it.

This trick relies on the fact that the program loaded or run must be able to understand the field passed to it. For example, *Word for Windows* understands the /n argument and looks no further; it simply ignores the .DOC. Similarly, any other program you try to load with this trick must be able to handle such a field by ignoring anything after the arguments. Trial and error will determine this.

Another way to easily get arguments to programs is to modify the entry in the [Extensions] section of WIN.INI. For example:

```
xxx=WINAPP.EXE /param1/param2
 ^.xxx
```

This can be done most simply by adding the parameters (such as /param1/param2) after the program name (such as WINAPP.EXE) in the Associate dialog box in File Manager.

It would be nice to disable *Excel*'s start-up Sheet1 the way Stork has outlined. However, *Excel* (at least Version 3.0), doesn't offer an /n argument.

OPENING WINDOWS

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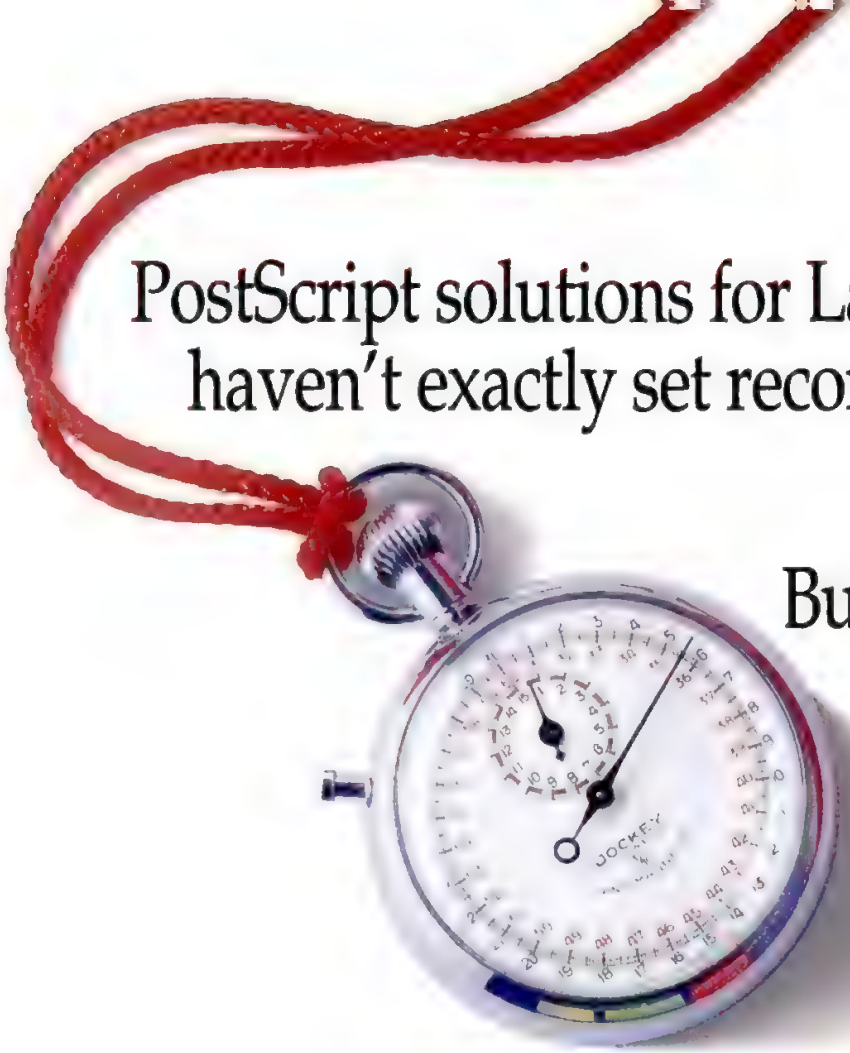

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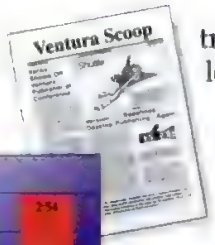

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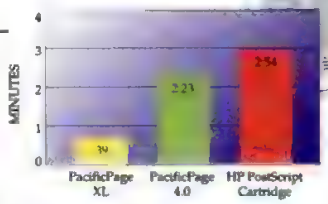

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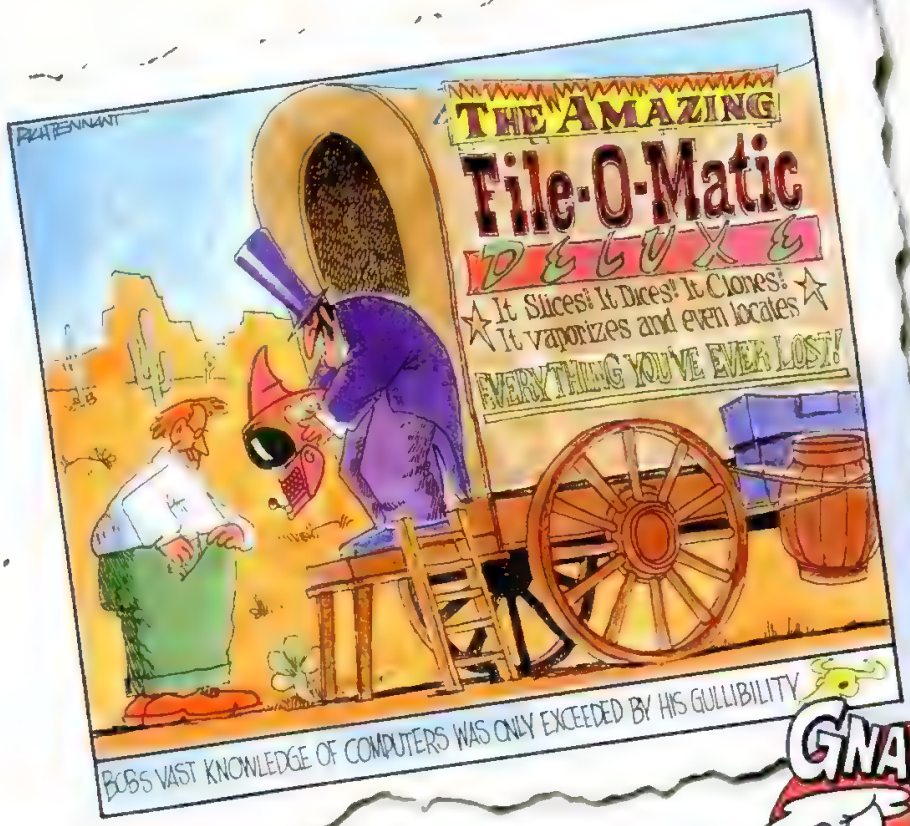

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by
Sal Ricciardi

Databases

A SET RELATION ANOMALY

One of the most powerful commands in *dBASE III Plus* is SET RELATION, which links two databases by a common key. However, SET RELATION has one quirk that can produce undesirable results. When *dBASE* searches the child database for the first key that matches the parent database's key, the matching record *dBASE* finds may be a deleted one—even if SET DELETED is ON. To avoid this problem, make sure that the child database contains no deleted records, by issuing a PACK command before creating the relation.

Roger W. Sauer
Fairfield, California

- **A SET RELATION ANOMALY:** You'll have to PACK your database if you don't want to pick up deleted records in a SET RELATION search.
- **LOCATING DUPLICATE RECORDS:** Using a UNIQUE index is an efficient way to find duplicates.

The SET DELETED command is supposed to tell *dBASE* whether other commands should include or ignore records marked for deletion. With SET DELETED ON, for example, FIND and SEEK will not match any record that has been marked for deletion.

Similarly, *dBASE* should not find a record marked for deletion when it searches for a SET RELATION match with SET DELETED ON. When *dBASE* finds no match, it would set EOF to true for that particular file, and you could test for this in your code.

Let's step through the process. When you establish a relation using the SET RELATION TO command, *dBASE* links the active database file to another database file via a common field or expression. For example, a CUSTOMER database can be linked to an ORDERS database on the customer ID field. The *parent* is the active database, and the *child* is the database *linked to* the parent.

Once the relation is established, both files are moved in sync. That is, when *dBASE* moves the record pointer in the parent file, it automatically searches for a matching record in the child file. So, using our example, when the CUSTOMER file is positioned to Smith's record, the ORDERS file will automatically be positioned to records containing orders placed by Smith.

If *dBASE* does not find a matching record, the pointer is positioned at the end of the file and the EOF() function will return .T. (true) for the child file.

That is how it *should* work. However, *dBASE III Plus*, *dBASE IV*, Version 1.0, and *FoxPro*, Version 1.02, all incorrectly match the deleted record. Only *dBASE IV*, Version 1.1 and *Clipper*, Summer 87, handle this situation correctly.

SET DELETED ON AND SET RELATION — **COMPLETE LISTING**

```
*
* RELATE.PRG
*
* This program illustrates whether or not your dBASE
* implementation respects the SET DELETED ON setting
* when using SET RELATION
*
* The sample databases CLIENT and TRANSACT can be downloaded
* from PC-MagNet
*
SET TALK OFF
SET ECHO OFF
SET ALTE TO TEST            && Results saved in TEST.TXT
SET ALTE ON
?
? VERSION()
*
SET DELETED OFF             && First try with SET DELETED OFF
SELE 1
USE client INDEX client_id
SELE 2
USE transact
SET RELATION TO client_id INTO client
GO 1
SELE 1
DELETE                      && Delete the record
SELE 2
*
? '1. EOF should be false -- '
? '   EOF()=',EOF()
? '   CLIENT name should appear -- '
? '   CLIENT->CLIENT='+CLIENT->CLIENT
?
SELE 1
?
? '2. EOF should be false -- '
     EOF()=',EOF()
*
* Now try the same thing with SET DELETED ON
*
SET DELETED ON              && Now try with SET DELETED ON
SELE 1
USE client INDEX client_id
SELE 2
USE transact
SET RELATION TO client_id INTO client
GO 1
SELE 1
DELETE                      && Make sure it's deleted
SELE 2
?
? '3. EOF should be false -- '
? '   EOF()=',EOF()
? '   CLIENT name should be blank -- '
?     CLIENT->CLIENT='+CLIENT->CLIENT
*
SELE 1
?
? '4. EOF should be true -- '
? '   EOF() ',EOF()
?
SET ALTE TO
RETURN
```

Figure 1: Run this program to see whether your *dBASE* implementation correctly respects the SET DELETED setting when a relation is set.

SET DELETED AND SET RELATION IN DBASE IMPLEMENTATIONS

	Client name should be blank (test 3)	EOF on deleted record should be true (test 4)
dBase III Plus	Present	.F.
dBase IV 1.0	Present	.F.
dBase IV 1.0	Blank	.T.
FoxPro 1.02	Present	.F
Clipper Summer 87	Blank	.T.

Figure 2: This lists the results of running the program in Figure 1 for each database listed. Only *dBASE IV* 1.1 and *Clipper*, Summer 87, return the correct results.

The program listed in Figure 1 tests to see whether your *dBASE* implementation correctly respects the SET DELETED setting when a relation is set. The table shown in Figure 2 lists the results when running the test program for several *dBASE* implementations.

If your *dBASE* implementation does not respect SET DELETED ON, you can PACK the database, as Sauer suggests, or explicitly test whether or not the record is deleted using the DELETED() function. If you're using *FoxPro*, Version 1.02, you can create a conditional index that excludes deleted records, using

```
INDEX ON <expression> FOR .NOT.
 DELETED
```

This command will ensure that there are no deleted records in the index.

LOCATING DUPLICATE RECORDS

After reading the October 30, 1990, Databases column, which discussed how to handle duplicate records in a *dBASE III* or *FoxBASE Plus* database, I wanted to share a technique I use.

I was asked to print a list of duplicates from a database containing names, addresses and birthdays. My first step was to determine an expression that could help pinpoint duplicates. For obvious reasons, I couldn't use the name fields alone. Also, since the database had been in existence for several years and wasn't very well maintained, I couldn't use the address fields as a search expression either.

Instead of updating a person's address when he or she moved, a new record with the new address was entered into the database. Another problem was that the addresses weren't entered in a consistent manner. For example, the word *Avenue* was sometimes entered completely, and other times it was abbreviated.

I finally decided to use a combination of last name, first name, and birthday. This seemed to be unique enough to find duplicates. The next step was to figure out how to actually locate the duplicates.

My method primarily makes use of the INDEX and DELETE commands. For example, using the above information, the following code will find the duplicate records in a database called MAIL and then copy the duplicates into a new database called DUP. The MAIL database is assumed to contain the following fields: LAST (character), FIRST (character), and BIRTHDAY (date):

```
* Example for finding duplicates

USE MAIL
INDEX ON TRIM(LAST)+TRIM(FIRST)+;
  DTOC(BIRTHDAY) TO NODUP UNIQUE
SET INDEX TO NODUP

* mark all unique
* records for deletion

DELETE ALL

* duplicates have NOT been marked
* for deletion

SET INDEX TO
SORT TO DUP ON LAST, FIRST ;
    FOR .NOT. DELETED()

* recall all records marked
* for deletion
RECALL ALL
```

This method makes use of the INDEX command with the UNIQUE option. The UNIQUE option allows any duplicate records that match the index expression to be excluded from the index. The DTOC() function converts the birth date into a character field. In order to keep this example simple and straightforward, I have assumed that all records in the database were entered in uppercase. For optimal duplicate checking, you should probably use the UPPER command while indexing.

Mitchell Kite
Middleton, Wisconsin

I've received several letters espousing the benefits of using a UNIQUE index when searching for duplicates in most *dBASE*-compatible languages. An index produced with the UNIQUE option contains a unique occurrence for every match on the key expression. All of the additional matches are possible duplicate records. By temporarily deleting all of the first occurrences, Kite's method makes it easy to filter out those records and concentrate on the possible duplicates—those that don't have the delete flag set.

Obviously, you need to use special care in determining the expression to use in identifying possible duplicates. In many situations more than one expression and more than one pass through the database may be needed.

The best approach to handling duplicate records is a combination of up-front prevention of duplicate key entry with a rigorous approach to identifying records that have gone beyond your first line of defense. The technique presented above will help you locate the ones that have.

Once you have identified possible duplicates, the safest and most thorough approach to dealing with them is for a qualified person to examine the list, as well as their corresponding first occurrences, to determine which records really are duplicates in context.

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by
Craig Stinson

Spreadsheets

ONE COMMAND, TWO RESPONSES

In *Quattro Pro* or *Lotus 1-2-3*, if you place the argument of a {GOTO} macro command in braces, the macro expects to find a named range. However, I've found that if a *Quattro Pro* macro must execute the instruction {GOTO}{G1} ~ and cell G1 contains an address, then the cell pointer actually goes first to G1 and ultimately to the address contained in G1. The same command in *Lotus 1-2-3*, Release 2.*x*, simply generates an error message.

In a macro-driven application, you could put this *Quattro Pro* behavior to good use. For example, you could provide a subroutine that would enable the operator to go somewhere in the worksheet, perhaps to correct a mistake, and then return to the original location.

Garfield R. Morgan
Lynn, Massachusetts

Mr. Morgan has discovered an interesting (and apparently undocumented) difference between *1-2-3* and *Quattro Pro*. In both programs, you can have a macro branch to a subroutine by enclosing the name of the subroutine's starting cell in braces, like this:

```
{Subroutine}
```

If a cell named Target contains the label D10, then the macro instruction

```
{GOTO}{Target}~
```

moves the cell pointer to D10. The sequence of events is as follows: First, the macro executes the {GOTO} command. This is equivalent to pressing the F5 key. Next, the macro branches to the cell named Target. Here it finds the label D10. The characters D, 1, and 0 are thus fed to the spreadsheet program, just as though they had been entered at the keyboard. Now, the macro returns to the original instruction, picks up right after {Target}, finds a tilde there, and executes a carriage return. The net result is exactly as though someone pressed the F5 key, typed D10, and hit Enter.

- **ONE COMMAND, TWO RESPONSES: When a cell address is placed in braces after a {GOTO} macro command, *Lotus 1-2-3* and *Quattro Pro* have different responses.**
- **A SIZE LIMITATION ON ALLWAYS GRAPHS: *Allways* will not let you print or view graphs larger than 32K, but you can use the superimposing features to overcome this barrier.**
- **A CLIPBOARD IN LOTUS 1-2-3: Use the Macro Library Manager in Release 2.2 as a utility for cut-and-paste operations.**

In both programs, if the word Target has not been assigned as a name for some cell or range, {GOTO}{Target}~ generates an "unrecognized name" error. However, *Quattro Pro* (unlike *1-2-3*) will attempt to read an unrecognized name as a cell address. So, to return to Morgan's example, if you write

```
{GOTO}{G1}~
```

and you haven't assigned any cell or range the name G1, *Quattro Pro* will say, "No such name. But I bet this person really means the cell address G1—not a cell or range named G1."

Whether you consider this laxity a benefit or a hazard depends on your programming style and taste for adventure. I'm inclined to think it's a hazard. In any case, don't write subroutine calls to unnamed ranges if you intend to use your macros in *1-2-3* as well as in *Quattro Pro*.

A SIZE LIMITATION ON ALLWAYS GRAPHS

Although it's not mentioned in the documentation for *1-2-3*, Release 2.2, the *Allways* add-in cannot handle graphs larger than 32K. If you try to add a graph whose .PIC file is larger than 32K, *Allways* displays an error message. To get around this limitation, I take advantage of the add-in's ability to superimpose graphs.

For example, if I save a graph consisting of two data series, each with 2,000 points, the 41K .PIC file that results is too large to use in *Allways*. But if I break this chart down into two, plotting the first series in one and the second in the other, I get two 21K .PIC files. By adding each file into exactly the same range in *Allways*, I get the original graph back—and I can print it along with my worksheet data.

Marcus Wilcox
Corvallis, Oregon

I tried using Wilcox's idea to plot 7½ years' worth of closing prices for Apple and IBM stock. The result is shown in Figure 1. The status line in this figure indicates that the current graph is AAPL.PIC. A second graph, named IBM.PIC, lies below AAPL.PIC. The frame, axes, and tick labels are all perfectly superimposed on both screen and printout (with a LaserJet II).

Obviously, you could extend this idea to plot additional series. If you wanted to be a little more creative, you could try superimposing graphs of different sizes. Try displaying a small pie chart within a single wedge of a larger pie, for example.

I have two caveats to point out: First, if you use the *Allways* /Graph Add command with a .PIC file larger than 32K, *Allways* will display the message "Cannot read .PIC file," followed by the name of your .PIC file. You must then use the /Graph Remove command to delete the

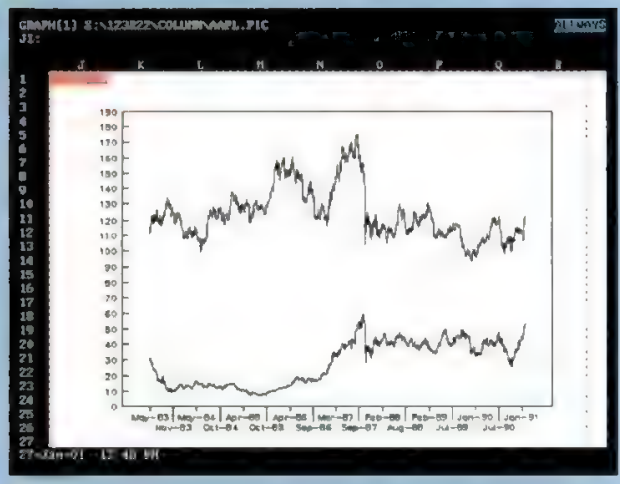

Figure 1: This shows how you can superimpose two graphs into the same range in *Allways* in order to overcome the 32K limit on graph size. In this example, you can view the graph IBM.PIC as well as the current graph APPL.PIC, that lies above it.

.PIC file—even though it was never added successfully. Be sure to do this before you go back to *1-2-3* to break the chart into smaller components. Otherwise, *Allways* will attempt to read the unreadable every time you scroll through the worksheet area where you tried to import it.

Second, if you perform the kind of superimposition described by Wilcox, be sure that each superimposed chart is plotted against the same *y*-axis and *x*-axis scales. You may need to scale the component graphs manually in order to accomplish this. If I had used default *y*-axis scaling for the component graphs of Figure 1, for example, AAPL.PIC would have had a *y*-axis ranging from 0 to 70, while the *y*-axis for IBM.PIC would have begun at 90 and ended at 180. Superimposing these default graphs would have created an unintelligible mess.

A CLIPBOARD IN LOTUS 1-2-3

Several of my programs have clipboard utilities, which let me paste parts of one file into another. I've become accustomed to working this way, and it frustrates me that *Lotus 1-2-3* doesn't have a clipboard. However, there is a way around the limitation. I've discovered that you can use the Macro Library Manager add-in in Release 2.2 for cut-and-paste operations.

To do this, first retrieve the spreadsheet that you want to cut from. Then invoke the Macro Library Manager and select Save from the menu. Name your library file—say, CLIPBORD—highlight the range you want to cut, press Enter, and select No Password. Then leave the source spreadsheet—*without saving*. This last caution is important: When you use the Save command, the saved range is erased, leaving a hole in the source spreadsheet.

Now retrieve the target spreadsheet—the one that you want to paste to. Place the cursor on the upper-left corner of the target area, invoke the Macro Library Manager again, and choose Edit. Select the CLIPBORD library file, press Enter, select Ignore, and press Enter again. This procedure pastes the contents of the clipboard file into the target spreadsheet.

> Release 2.2's Macro Library Manager can be used for purposes other than managing macro libraries.

I use CLIPBORD over and over as a temporary file for transferring data between worksheets. I also have other "macro" libraries that store worksheet templates. Each template is stored in a separate library. Any time I want to use one of these templates, I just invoke the Macro Library Manager's Edit command and specify the library with the template I want.

Dan Bailey
Hudson, Ohio

PC MAGAZINE Bailey is right. Release 2.2's Macro Library Manager can be used for purposes other than managing macro libraries. The Release 2.2 reference manual alludes to its serviceability as a template manager but stops short of recommending its use as a general-purpose clipboard.

There are two pitfalls that you need to be aware of if you adopt Bailey's cut-and-paste approach.

The first has to do with range names. Let's say you cut a range that includes the name TOTALS. If the worksheet into which you paste also has a range named TOTALS, one or the other name gets the axe. When you use the Edit command to paste in your clipboard data, you can choose Ignore (to leave the worksheet's range names alone) or Overwrite (to write over conflicting range names). To avoid having to make this decision, you might want to use the /Range Name Table command before you cut from the source worksheet. If the range you want to cut includes any names, you could modify the names to avoid conflicts with names in the target worksheet.

The second—and more serious—pitfall concerns formulas that reference cells outside the cut range. Those references may be relative, absolute, or mixed, but *1-2-3* treats them as *relative* when you use the Macro Library Manager's Edit command. So you must set up your target worksheet just like your source worksheet (and you must paste the contents of your clipboard library into the same cell coordinates from which you extracted it). Otherwise, transferring formulas of this kind is likely to get you into trouble. On the other hand, transferring formulas that refer to other cells within the cut range is not a problem at all.

Finally, before using Bailey's cut-and-paste procedure, remember to attach the Macro Library Manager. You can do that by typing /AA (/Add-in Attach) and choosing MACROMGR.ADN.

HINTS, TIPS, QUESTIONS

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—InfoWorld, February 4, 1991

InfoWorld Report Card				January 7, 1991
Professional Word Processors	Ami Pro® 1.2b	Wordstar® 6.0	Word for Windows	WordPerfect® 5.1
Basic editing	Very good	Very good	Excellent	Very good
Ease of learning	Very good	Good	Excellent	Very good
Ease of use	Very good	Good	Excellent	Very good
Overall score	7.8	6.6	8.3	8.0

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by
Costa Rodis

The Working Word

- FIND THE CURSOR IN WORDPERFECT: The advantages and limitations of CURSOR.COM.
- IS IT REALLY WYSIWYG?: Limitations of the *Word for Windows* ruler.
- QUICK SAVES IN WORDPERFECT: Forget the F10 Replace? routine. You can save your documents with a single keystroke combination.

FIND THE CURSOR IN WORDPERFECT

Laptop users usually have a hard time finding the cursor. While you can find software that will enlarge it, spending money on such a utility may not be necessary. *WordPerfect*'s CURSOR .COM does the job free. Just type CURSOR at the DOS prompt and a grid of dots will appear on-screen. Move the cursor around the grid and it changes size with each dot. Note the coordinates of the cursor size you like and enter CURSOR/*xx*, where *xx* are the coordinates. Enter the line into your AUTOEXEC.BAT file, and the cursor will never get lost. Since CURSOR.COM is run from DOS, it will work with many applications, not just with *WordPerfect*.

Charles L. McGehee
Ellensburg, Washington

Ever since it arrived with *WordPerfect* 4.2, CURSOR.COM has been included with the program. Not all coordinates of the grid will be accessible to everyone. Which part is available to you depends on the type of monitor you have. For example, with the CURSOR.COM that comes with *WordPerfect* 5.1, coordinate AE provides me with the largest cursor I can find for use with my VGA monitor.

If you want to test CURSOR.COM, go to your *WordPerfect* directory (for example, C:\WP51) and type CURSOR. A grid pops up with the characters A through N ranging across the top and down the left side. The left side is labeled First Letter and the top of the grid is labeled Second Letter. Your computer's default cursor type flashes on the grid. As you move the cursor, it changes shape and size. The current position of the cursor on the grid is displayed at the bottom of the screen with the message "You may select this cursor from DOS by entering: CURSOR/*xx*." When you find a cursor type you like, tap Enter and the cursor will retain its new configuration until you reboot, load a program that resets the video mode, or run the CURSOR.COM utility again.

As McGehee suggests, you may prefer having your PC boot up with the cursor type you like by including CURSOR/*xx* in your AUTOEXEC.BAT file. Don't forget to include the full path, such as C:\WP51\CURSOR/*xx*, if *WordPerfect* isn't already in your path.

Although your new cursor shape and size will look as good in other programs as it does in *WordPerfect*, some programs may size the cursor to a default shape. For instance, most spreadsheet packages force the cursor to retain the standard blinking line until you exit. Graphics programs are not affected by CURSOR.COM at all. Since any program that does change the cursor shape is likely to keep it changed when you exit back to DOS, you may want to create a batch file that restores the cursor to your preferred shape.

IS IT REALLY WYSIWYG?

What's going on with the *Word for Windows* display? It seems to be only somewhat WYSIWYG.

Windows tells me I have dozens of fonts, point sizes and spacing options (characters per inch) available, but very few of them print out to the line length I see on the screen. For example, with a line length of 6 inches, using 6-point type, word wrap might occur at 4.5 inches, as measured on the ruler. However, a 6-inch line will be printed. In essence, the ruler is rendered useless as a format tool. What, if anything, can be done to rectify the problem? Am I doing something wrong?

Eddie Nicholson
Brookston, Texas

Does any word processing program truly reflect on-screen what comes out at the printer? If one does, I've never seen it. Part of the problem lies in translating the dot pitch and resolution of a monitor to the resolution of a particular printer. Matching screen and printer fonts precisely is unlikely until monitors and printers actually mirror each other's physical output. Making the display perfectly flat and an exact match of screen and printer colors would also bring us much closer to the precision we all crave.

To test Nicholson's complaint, I made print samples of several different monospaced and proportional fonts, indicating on each sample the precise location of a tilde as measured against the *Word for Windows* ruler. I then repeated the experiment with *Ami Pro*, *WordPerfect* 5.1, and *Word* 5.0.

With *Word for Windows* it seems we must make do with an imperfect world. For example, Version 1.0 positions the ruler over Courier perfectly well; however, when it comes to most proportional fonts, the package is far off the mark. On the other hand, the recent *Word for Windows* upgrade seems to measure proportional fonts accurately, while monospaced Courier prints beyond the ruler's setting.

Ami Pro displays screen fonts with

good accuracy in relation to the tab line. A comparison of the two packages leads me to believe that the *Word for Windows* problem lies not with the screen fonts. Rather, as Mr. Nicholson has suggested, the ruler is not reliable as a measuring tool.

I also looked at *WordPerfect* 5.1 and *Word* 5.0. Although both programs are perfectly accurate in showing the cursor's position with monospaced text, they are more imprecise with proportional typefaces. Because neither program is graphical, you find the character's true position by referring to a line prompt at the bottom of the screen; this prompt only indicates the current location of the cursor. Positioning of text, whether monospaced or proportional, is usually accurate when placed by tab, indent, or other absolute technique, such as *WordPerfect*'s Advance format.

QUICK SAVES IN WORDPERFECT

I like to periodically save the document I'm working on in *WordPerfect* 5.1. *WordPerfect* is a powerful word processor, but its extensive use of function keys makes saving and replacing files a tedious chore. Instead of using the F10 key or the F5 key (for ASCII files), I have created the following macros (Figures 1 and 2): Alt-S for saving and replacing regular *WordPerfect* files and Alt-R for saving and replacing ASCII files.

Each macro checks to see whether you are editing a previously saved document; if you are, it replaces the old file. If you're working on a new document, the macro prompts you for a filename and saves the document.

Norman Chan
Winnipeg, Manitoba, Canada

ALTS.WPM — COMPLETE LISTING

```
{DISPLAY OFF}
{ASSIGN}filename~name~~                {;}Assign·document·name·to·"filename".~
{IF EXISTS}filename~                   {;}If·filename·exists,·macro· saves·file...~
{ELSE}                                 {;}Otherwise...~
   {BELL}                              {;}an·error·tone·sounds...~
   {TEXT}filename~Enter·filename:·{^\}~
                                       {;}and·user·prompted·to·enter·a·name,
                                       {;}which·is·then· assigned·to·"filename"~
{END IF}
{Save}{VARIABLE}filename~{Enter}       {;}Save·document·w/filename.~
{IF}{STATE}&1024~                      {;}If·a·Y/N·condition·exists...~
   Y                                   {;}...enter·Y...~
   {PROMPT}{^\}old·{^R}·{VARIABLE}filename~·{^Q}·was·replaced!~
                                       {;}display·Replaced·message.~
{ELSE}                                 {;}Otherwise...~
   {PROMPT}{^\}File·{^R}·{VARIABLE}filename~·{^Q}·saved!~
                                       {;}display·Saved·message~
{END IF}
   {WAIT}20~                           {;}display·either·message·for·20·seconds.~
```

Figure 1: When you're working with regular WordPerfect files, this Alt-S macro makes it faster to save new documents or replace old ones.

ALTR.WPM — COMPLETE LISTING

```
{DISPLAY OFF}
{ASSIGN}filename~name~~                {;}Assign·document·name·to·"filename".~
{IF EXISTS}filename~                   {;}If·filename·exists,·save·file.~
{ELSE}                                 {;}Otherwise~
   {BELL}                              {;}an·error·tone·sounds...~
   {TEXT}filename~Enter·ASCII·filename: ·{^\}~
                                       {;}and·user·prompted·to·enter·name,·which·is~
                                       {;}assigned·to·variable·"filename"~
{END IF}
{Text In/out}ts{VARIABLE}filename~{Enter}
                                       {;}Save·document·w/filename.~
{IF}{STATE}&1024~                      {;}If·a·Y/N·condition·exists...~
   Y                                   {;}enter·Y...~
   {PROMPT}{^\}old·text·file·{^R}·{VARIABLE}filename~·{^Q}·was·replaced!~
                                       {;}and·display·Replaced·message.~
{ELSE}                                 {;}Otherwise~
   {PROMPT}{^\}Text·File·{^R}{VARIABLE}filename~·{^Q}·saved!~
                                       {;}display·Saved·message.~
{END IF}
{WAIT}20~                              {;}Display·either·message·for·20·seconds.~
```

Figure 2: This macro is similar to ALT-S, but is used for saving and replacing ACSII files.

These macros are effective, simple, and extremely useful. I like them so much that I've mapped them to my keyboard as Ctrl-S and Ctrl-A so that I can continue using Alt-S and Alt-R for other purposes.

What makes these macros so efficient is Chan's smart and early use of the {ASSIGN} command to place the current document name (which is known to *WordPerfect* as {SYSTEM}name~) into the *filename* variable. Now, the command {VARIABLE}filename ~ automatically enters the document name wherever it is required in the macro.

The {^\} indicates the start of bold, the {^R} (Ctrl-R) marks the beginning of reverse video, and {^Q} (Ctrl-Q) ends all previously indicated text attributes. All the other commands in brackets can be accessed only by using Ctrl-PgUp from within the macro Action screen (Ctrl-F10, macro name, Edit (2)).

You should note that when any kind of IF statement, such as {IF EXISTS}, is used in these macros, it must end with an {END IF} command. {ELSE} should be used whenever you want an alternative action to take place. If {ELSE} were not used in the ALTS.WPM and ALTR.WPM macros, you would only be able to save an already existing document. There would be no provision for saving a document that has not yet been saved; nothing would happen when the macro was run.

The {IF}{STATE}&1024 ~ statement asks the *WordPerfect* environment to determine whether a yes/no condition currently exists. This condition does occur during a save if the document has already been saved at least once. Since it's assumed that you only use this macro to quickly save edits, a Y follows this statement so that the document is automatically saved with the current document name. It doesn't give you an opportunity to save with a new name.

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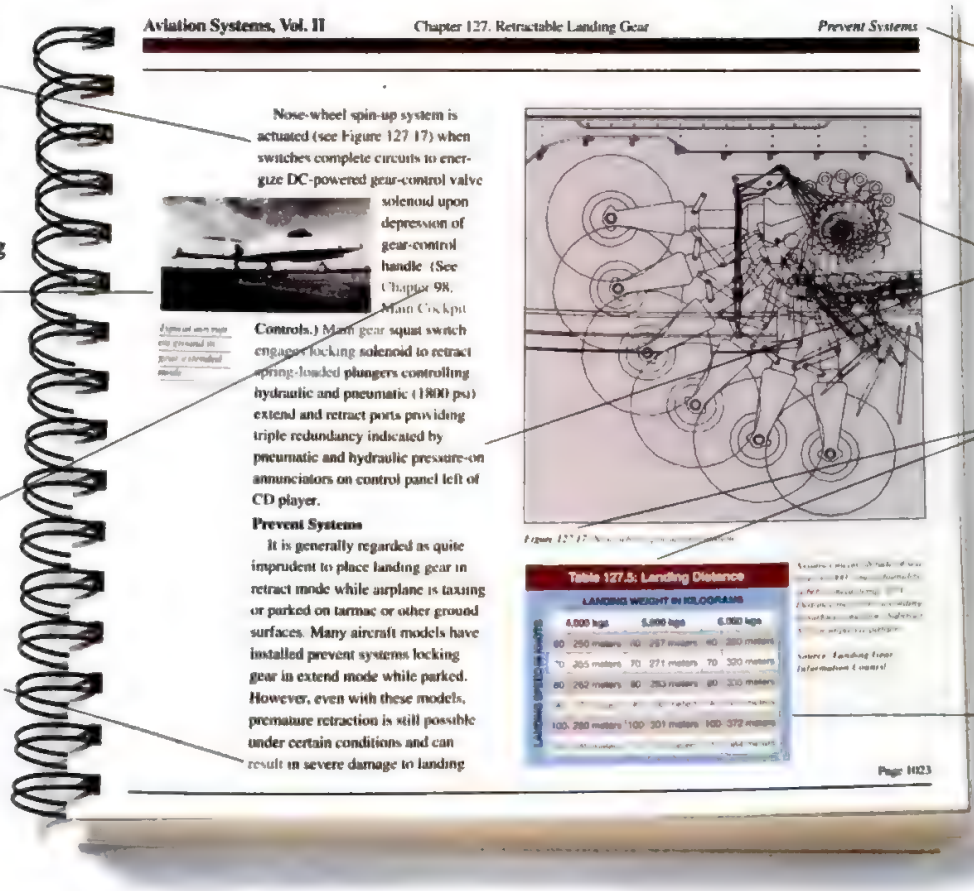

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CIRCLE 247 ON READER SERVICE CARD

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CIRCLE 181 ON READER SERVICE CARD

by
Neil J. Rubenking

User-to-User

TUNING YOUR AUTOEXEC

"More Speed, Less Space" (April 10, 1990) was informative, but a few things should be added. When you copy AUTOEXEC.BAT to a RAM disk, rename it (say, to REFRESH.BAT) to assure that no mixups will occur when the file is being changed, deleted, or run.

The instructions in my AUTOEXEC fall into two categories: those that are harmless when reexecuted (PROMPT and PATH) and those that would be disastrous to reexecute (TSRs that crash the system when executed more than once). Because %0 is null when AUTOEXEC is called by the boot process but has the value AUTOEXEC any other time it runs, you can prevent reloading dangerous TSRs. The revised AUTOEXEC might look like this:

```
IF NOT '%0'==' GOTO again
RAMDISK C: /M=100
REM  one-time programs/commands
 go here
COPY AUTOEXEC.BAT C:REFRESH.BAT
C:REFRESH
:again
REM  reusable programs/commands
 go here
```

To prevent users from typing AUTOEXEC to get to REFRESH.BAT, you can add these lines at the beginning:

```
IF NOT '%0'=='AUTOEXEC' GOTO
 bootchek
ECHO Please use the command
ECHO REFRESH to restore system
ECHO default settings
TYPE C:QUIT.BAT > C:QUIT.BAT
C:QUIT
:bootchek
```

QUIT.BAT is a zero-length batch file that simply terminates and returns to DOS. Note that this example is not robust enough for production use (it's case-sensitive) but it illustrates the point adequately.

Robert Cutler
Gold River, California

- **TUNING YOUR AUTOEXEC:** Don't let your AUTOEXEC.BAT reexecute dangerous commands.
- **RECURSIVE BATCH FILES:** A batch file that can call itself lets you handle nested .ZIP files.

PC MAGAZINE Though most TSR programs are smart enough to know that they should not load themselves more than once, there are some that will try to do it. If they succeed, you have two copies of the TSR using up valuable RAM. If they fail, they can crash your system. By setting up your AUTOEXEC properly, you avoid that possibility.

A batch file can have up to nine command line parameters numbered %1 through %9. DOS fills in the %0 parameter with the name of the batch file itself, just as it was typed at the keyboard. The initial loading of AUTOEXEC.BAT is a special case, though—the filename does not get put into the %0 parameter.

> By setting your AUTOEXEC.BAT properly, you can prevent TSRs from loading more than once and crashing the system.

There are a couple of points to note about the second set of example batch lines. First, the author comments that the initial test is case-sensitive. That isn't really a problem, since we can replace that first line with the following one:

```
IF '%0'==' GOTO bootchek
```

Second, he creates QUIT.BAT, a zero-byte batch file, on the spot. You may want to put a QUIT.BAT in your batch file directory so that you can use it in any of your batch files. It's handy to be able to just call QUIT to get out of a batch file, and it takes no more disk space than the 32-byte directory entry.

RECURSIVE BATCH FILES

Many of the files I download from bulletin boards are compressed into .ZIP files, and these .ZIPs often contain various advertisement files the BBS adds to *every* ZIP on the board. I want to be able to check the downloaded files for viruses, and to delete the advertisement files before I archive them to floppies.

I built a batch file to automate the process. It works fine on all files, including .ZIPs, as long as they don't have other .ZIP files embedded in them. If there are nested .ZIPs, the only solution I've been able to figure out is to unzip all embedded ZIPs to a single subdirectory, check the files for viruses, and then erase this directory, leaving the original embedded .ZIP file untouched. While this accomplishes some of what I need, it still leaves me with a lot of tedious work to do. Is there any way to solve the problem without having to go through all of these steps?

Tom Black
McHenry, Illinois

PC MAGAZINE The solution is a *recursive* batch file—one that can call itself repeatedly. I modified the original batch file into a trio of batch files that work together to handle any level of nested ZIPs. The basic batch file, PROCESS.BAT in Figure 1, is extremely simple. First it calls PROCNORM.BAT (Figure 2), which

PROCESS.BAT COMPLETE LISTING

```
@ECHO OFF
REM *** This is PROCESS.BAT ***
ECHO Now processing files in:
CD
CALL PROCNORM.BAT
FOR %%v IN (*.ZIP) DO CALL PROCZIP.BAT %%v
REM IF using DOS prior to 3.3, replace "CALL" in the two
REM lines above with "COMMAND /C"
```

Figure 1: This batch file is part of a trio of programs that perform specified operations on all files in a directory, including those inside .ZIP files.

contains all the actual file-processing commands. Then for each .ZIP file in the current directory, it calls PROCZIP.BAT (Figure 3). PROCZIP creates and moves to a temporary directory, then decompresses the .ZIP file into that directory. Clearly all three batch files must reside in a directory on your path.

After it puts all of the files into the temporary directory, PROCZIP calls PROCESS again. As before, PROCESS calls PROCNORM to check for viruses and delete certain files. PROCESS then calls PROCZIP on any .ZIP files that it finds in the current directory—these are .ZIP files that were nested inside the original .ZIP file. When it finishes, it deletes the original .ZIP file and re-creates it with the current contents of the temporary directory. Note that any directory structure *within* the .ZIP file will be lost in this process. Finally, it returns to the parent directory and removes the now-empty temporary directory.

The important thing to note is that the processing of a .ZIP file always takes place in a subdirectory below the location of the .ZIP file itself. Suppose you started in the directory C:\INCOMING. During the processing of the first .ZIP file, you'd be working in C:\INCOMING\TEMPZIP.$$$. If you encountered a .ZIP file in that directory, you'd process its contents in C:\INCOMING\TEMPZIP.$$$\TEMPZIP.$$$. The only limit on the number of nested ZIPs is the length of a DOS path. If you encounter this limit, switch to using a shorter name for the temporary directory.

PROCZIP.BAT COMPLETE LISTING

```
@ECHO OFF
REM *** This is PROCZIP.BAT ***
MD TEMPZIP.$$$
CD TEMPZIP.$$$
PKUNZIP ..\%1
CALL PROCESS.BAT
REM If you're running DOS prior to
REM 3.3, replace "CALL" in the
REM line above with "COMMAND /C"
DEL ..\%1
PKZIP -m ..\%1 *.*
CD ..
RD TEMPZIP.$$$
```

Figure 3: PROCZIP extracts the contents of a .ZIP file and processes the files, making a recursive call to PROCESS.BAT (Figure 1).

PROCNORM.BAT COMPLETE LISTING

```
@ECHO OFF
REM *** This is PROCNORM.BAT ***
STRIPZIP *.ZIP
REM STRIPZIP strips comments from ZIP files.  Delete
REM the above line if you don't have STRIPZIP.
IF EXIST INTRO.TXT ERASE INTRO.TXT
IF EXIST READ_1ST.EXE ERASE READ_1ST.EXE
IF EXIST DO_READ.ME ERASE DO_READ.ME
IF EXIST READ_ME.750 ERASE READ_ME.750
IF EXIST READ-ME.512 ERASE READ-ME.512
IF EXIST HAPPY.BBS ERASE HAPPY.BBS
IF EXIST HAPPY.EXE ERASE HAPPY.EXE
IF EXIST READ-ME.PLS ERASE READ-ME.PLS
IF EXIST UGLY.COM ERASE UGLY.COM
IF EXIST GOOD.COM ERASE GOOD.COM
IF EXIST BAD.COM ERASE BAD.COM
IF EXIST WELCOME.TXT ERASE WELCOME.TXT
IF EXIST HOWDY.TXT ERASE HOWDY.TXT
IF EXIST HOWDY.EXE ERASE HOWDY.EXE
IF EXIST ALLREAD.ME ERASE ALLREAD.ME
IF EXIST READ-PLS.EXE ERASE READ-PLS.EXE
REM Scan for all know viruses in the primary directory
REM Substitute your own favorite virus scanner if you wish.
SCAN *.* /a /nomem /x /m
REM if Scan returns an errorlevel of 1 or 2,
REM post a message on the screen
IF ERRORLEVEL 1 ECHO Warning!!! SCAN.EXE indicates Virus infection!!!!
IF ERRORLEVEL 2 ECHO Warning!!! SCAN.EXE terminated abnormally, ...!
IF ERRORLEVEL 2 ECHO    Proceed with Caution!!!!
REM  Get my attention if there's a virus or problems
IF ERRORLEVEL 0 GOTO QUITOK
REM  Replace ^Gs in next line with Ctrl-Gs
ECHO ^G^G^G^G^G^G^G^G^G^G
ECHO Please press Ctrl-Break and deal with virus-infected
ECHO file.  Then delete all the TEMPZIP.$$$ subdirectories
ECHO and their contents and start processing again.
PAUSE
ECHO I said, press Ctrl-Break!
REM ^C in next line is Ctrl-C.  Note that next line works
REM only in DOS 3.3 or higher.
ECHO ♥ | PAUSE > NUL
:QUITOK
```

Figure 2: PROCNORM handles processing of normal files—in this case it scans for viruses and deletes certain "advertising" files.

Of course, your needs won't be the same as this reader's. All of the normal file processing is isolated in PROCNORM.BAT, so just edit it to do what *you* want. The one thing you must avoid in PROCNORM.BAT is changing the current directory.

These batch files depend on the CALL command, introduced in DOS 3.3. If you're using an old version of DOS, replace each instance of CALL with COMMAND /C or %COMSPEC% /C.

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edited by
Trudy Neuhaus

Languages

ACCESSING TEXT-MODE VARIABLES

The letter, "Using 43- and 50-line EGA and VGA Modes," which appeared in the April 24, 1990, Languages column, mentioned that the Turbo C 2.0 runtime library maintained 2 undocumented bytes containing the screen height and width. After digging around with Turbo Debugger, I found that Turbo C uses a system label, `_video`, that is the base of the `text_info` structure defined in CONIO.H:

```
struct text_info {
    unsigned char winleft;
    unsigned char wintop;
    unsigned char winright;
    unsigned char winbottom;
    unsigned char attribute;
    unsigned char normattr;
    unsigned char currmode;
    unsigned char screenheight;
    unsigned char screenwidth;
    unsigned char curx;
    unsigned char cury;
};
```

The contents of the structure pointed to by `_video` are nearly identical to those returned by the Turbo C library function, `gettextinfo`, with a few exceptions. First, while Turbo C uses 1,1 as the coordinate pair to represent the upper-left corner of the display, the `_video` versions of the first four structure members have values that are 1 less than expected, and they use 0,0 as the starting coordinates. Further, the last two members of the structure—`curx` and `cury`, which define the current cursor position—are not maintained at all: instead, their values are calculated via a BIOS call whenever they're needed.

You can use a cast to access `_video` as a `text_info` structure, which is easier and faster than calling `gettextinfo`. But since this subverts any error-checking and range checking on Turbo C's part, you should take care—particularly if you are going to modify these values.

William Spahn
San Francisco, California

- **ACCESSING TEXT-MODE VARIABLES:** Two ways to access the same video information in Turbo C.
- **TIMED DELAYS IN BASIC:** How to implement timed delays that are hardware-independent.

PC MAGAZINE Spahn's example program illustrates his points well. Using the same body of code, a pointer to `_video` and a structure filled in via `gettextinfo`, we get the same results with the exceptions he describes.

The program, VIDEO.C shown in Figure 1, creates a window in the center of the screen with black letters on a cyan background. Then it displays the members of a `text_info` structure filled in with `gettextinfo`, and follows with the data pointed to by `_video`.

I was able to shrink the program listing a little by consolidating all of the pointer access and display code into a single function, `display_textinfo`. I also used an ANSI C trick, string concatenation to make the listing a little more readable: The CRLF macro expands to "\n\r". Thus, the expression

```
cprintf(CRLF CRLF "...
```

expands to

```
cprintf("\n\r\n\r...
```

VIDEO.C 1 of 2

AVAILABLE ON PC MAGNET

```
// video.c

#include    <stdio.h>
#include    <conio.h>

extern char _video;                                  // declare external variable

#define TextColor(foreground,background)    (foreground+(background<<4))
#define CRLF    "\n\r"

void display_textinfo(struct text_info *t);

void main(void)
    {
    struct text_info textinfo, *viddata = (struct text_info *)&_video;

    window(10,5,70,22);                              // set window size
    textattr(TextColor(BLACK,CYAN));                 // set text colors
    clrscr();                                        // clear screen
    gettextinfo(&textinfo);                          // TC function

    cprintf(CRLF "Data returned by gettextinfo():" CRLF);
    display_textinfo(&textinfo);

    cprintf(CRLF "Data acquired via _video and direct memory access:" CRLF);
    display_textinfo(viddata);

    cprintf(CRLF CRLF CRLF "Press any key to continue...");
    getch();

    window(1,1,80,25);
    textattr(TextColor(LIGHTGRAY,BLACK));
    clrscr();
    }
```

Figure 1: Running VIDEO.C shows that the data returned via `gettextinfo` is nearly the same as that acquired by accessing the `_video memory` variable. You can compile VIDEO.C with Turbo C, Turbo C++, and Borland C++.

VIDEO.C 2 of 2

```
void display_textinfo(struct text_info *t)
    {
    cprintf("Window parameters: left=%d top=%d right=%d bottom=%d" CRLF,
        t->winleft,t->wintop,
        t->winright,t->winbottom);
    cprintf("Current Text Attribute:%d  Normal attribute:%d" CRLF,
        t->attribute,
        t->normattr);
    cprintf("Video mode:%d" CRLF,t->currmode);
    cprintf("Screen dimensions (width x height): %dx%d" CRLF,
        t->screenwidth,
        t->screenheight);
    cprintf("Cursor Position: X=%d Y=%d" CRLF,t->curx, t->cury);
    }
```

When two or more string constants are separated only by white space, a compiler that conforms to ANSI C (as does Turbo C) will concatenate those strings.

By running the program, you can see for yourself that the data returned via `gettextinfo` is nearly the same as that acquired by accessing the `_video` memory variable. You can compile VIDEO.C with either Turbo C or Turbo C++ as follows:

```
TCC video.c
```

or you can use

```
BCCX video.c
```

to compile the program with Borland C++.—*Richard Hale Shaw*

TIMED DELAYS IN BASIC

There are many occasions when it is necessary to insert timed delays into a BASIC program. For example, you may want to control the speed of animation for a bouncing ball or a special effect in a game. You may also need to control how long help or other information screens are displayed for users to read. These delays, whether very brief or seconds long, should remain the same, regardless of the speed of the PC the program is executing on.

I devised a method to increment a variable for a fixed amount of time, using BASIC's built-in TIMER function, and then using the resultant value as a control within a FOR/NEXT loop. Besides ensuring that the delay times are consistent across varying hardware, this technique also lets you create delays with a finer resolution than would otherwise be possible.

Robert W. Moell
Wake Forest, North Carolina

I took the liberty of optimizing Moell's example code. I found it added a 5-second initial delay when the program was run, and the two routines were not entirely complementary. Further, using the TIMER function would add the floating-point library routines to a program that might otherwise not require them. The idea is a good one, however, and the two short subroutines and demonstration program in Figure 2 show my implementation.

Here, the CalcDelay function calculates a "fudge factor" that is then used by the DoDelay subprogram. CalcDelay simply increments a long integer variable repeatedly for the duration of a system timer tick (about 1/18 second), and returns the final tally. DoDelay then uses that to determine how many times to execute an empty DO loop. The value 40 was arrived at empirically (that is, I stabbed at it until it gave the desired result), however testing on a variety of computers showed the delays to be extremely consistent.

One useful side benefit of these routines is that CalcDelay may also be used by itself to provide some sense of a given PC's overall throughput. Of course, this is not intended to serve as a substitute for a real CPU speed-testing program.
—*Ethan Winer*

TWO TIMED DELAY ROUTINES

```
DECLARE FUNCTION CalcDelay& ()
DECLARE SUB DoDelay (MSecs%, Factor&)

Factor& = CalcDelay&
INPUT "Enter a delay period in milliseconds: ", MSecs%
PRINT "Stand by/..."
CALL DoDelay(MSecs%, Factor&)
PRINT "Done!"

FUNCTION CalcDelay& STATIC

    Fudge& = 0                          'clear the "fudge factor" accumulator
    DEF SEG = 0                         'look at the timer bytes in low memory

    Start% = PEEK(&H46C)                'look at the current low-byte count
    DO                                  'wait until that byte just changes
    LOOP WHILE PEEK(&H46C) = Start%     '  (up to 1/18th second)
    Start% = PEEK(&H46C)                'get the new low-byte count again

    DO                                  'now we're synced up with the start of
        Fudge& = Fudge& + 1             '  a new, full 1/18th second period
    LOOP WHILE PEEK(&H46C) = Start%     'accumulate the count for 1/18th second

    CalcDelay& = Fudge&                 'assign the function output
    DEF SEG                             'restore BASIC's original segment

END FUNCTION

SUB DoDelay (MSecs%, Factor&)

    FOR X% = 1 TO MSecs%
        LoopTime& = Factor& \ 40
        DO
            LoopTime& = LoopTime& - 1
        LOOP WHILE LoopTime&
    NEXT

END SUB
```

Figure 2: This pair of routines lets a BASIC program implement millisecond delay periods independently of the PC's processor speed.

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by
Jeff Prosise

Tutor

UNDOCUMENTED DOS UPDATE

It's funny how hard-to-find information on a subject can turn up just when you need it. No sooner had I turned in the copy for the February 12, 1991, Tutor column discussing undocumented DOS API functions than a new book from Addison-Wesley appeared, documenting many of the inner workings of DOS that had been kept secret for all these years.

Written by Andrew Schulman, Raymond J. Michels, Jim Kyle, Tim Paterson, David Maxey, and Ralf Brown, *Undocumented DOS* discusses, among other things, DOS memory and device management, the DOS file system and network redirector, terminate-and-stay-resident programs, and command interpreters. (If the name Tim Paterson sounds familiar to you, it could be because he authored the operating system 86-DOS from which DOS was derived and later authored DOS 1.*x* during his tenure at Microsoft.)

The book documents dozens of formerly undocumented DOS API functions and many of DOS's internal data structures, such as memory control blocks, system file tables, disk buffers, drive parameter blocks, SHARE.EXE lock records, and current drive structures. It also discusses the version dependencies of these functions and data structures.

If you're curious to know more about how DOS works and about resources available to programmers than the manual or even *The MS-DOS Encyclopedia* tells you, then this book is a must-buy. It's the only reference work currently available that brings together everything the world outside Microsoft and IBM knows about the internals of DOS, and it represents literally years of work spent disassembling code and reverse-engineering the operating system.

CORRECTION

Sharp-eyed readers may have noticed a typographical error in Figure 1 of the same Tutor column (February 12, 1991).

- UNDOCUMENTED DOS UPDATE: An important new book expands the information presented in this column.
- REDIRECTION AND PIPING: Knowing how to put redirection and piping to work is one step toward making better use of your system.

On page 400, the offset for the segment address of the first memory control block in the List of Lists should have read -02, not 02. In fact, if you look up function 52h in *Undocumented DOS*, you'll find that there are additional fields preceding the MCB address field in the List of Lists, of which I was previously unaware. This illustrates one of the inherent dangers in writing about undocumented features of DOS: You can never be sure that you've covered all the bases or that what you've written is entirely accurate. *Undocumented DOS* unravels many of these unsolved mysteries, and it's sure to be a popular reference work for years to come.

REDIRECTION AND PIPING

Every now and then readers write to say that we've lost sight of who our readership really is and what level of ability they operate at. Their letters suggest that we're so concerned with satisfying the so-called "power users" that we forget there are still many beginning and intermediate-level users out there who don't know an interrupt from a wait state. That's why this Tutor column will focus on a topic as fundamental to DOS as the command line itself, but one that is widely misunderstood by novices and power users alike: redirection and piping.

You've probably seen them before: long commands that combine DOS commands with greater-than signs, less-than signs, and vertical bars. Commands such as

```
TYPE TEXTFILE.TXT | MORE
```

which displays a text file one screen at a time rather than in one long, scrolling listing, and

```
COPY *.* F:\ > NUL
```

which copies everything in the current directory to drive F:, but suppresses the "files copied" message that normally clutters the screen afterward. In each case, the output from one command was captured and routed to a destination other than the screen. In the first example, the output from one command was actually used as the input to another. But these are just isolated examples of the many things you can do with the facilities DOS provides for redirecting input and output. We'll examine redirection in a more general sense and attempt to paint a broader picture of the ways you can apply it.

The two channels DOS uses for most of its screen and keyboard I/O are known as *standard output* and *standard input*. DOS maintains an internal table that records the relationships among *file handles*—unique numbers assigned by DOS that programs use to refer to files or devices opened with DOS's Open File kernel function. File handles 0 and 1 are reserved for standard input and standard output. These two file handles are automatically mapped to the CON (console) device driver (or ANSI.SYS if that was installed with a DEVICE= directive in CONFIG.SYS) so that data written to standard output normally goes to the screen, and data read from standard input comes from the keyboard. What redirection actually does is to reroute data sent to standard output and received from standard input.

DOS provides three different redirection operators:

> the *output redirection* operator, which

redirects command output from the screen to a destination you specify;
< the *input redirection* operator, which redirects command input from the keyboard to a source you specify; and
| the *piping* operator, which pipes the output of one command to the input of another.

These operators add a great deal of flexibility to the system. For example, using output redirection, it's possible to capture output from a DOS command such as CHKDSK to a file or to send it to the printer. With input redirection, you can substitute instructions stored in a script file for those typed at the keyboard. Output redirection intercepts DOS output headed for the screen and routes it to a secondary destination. Input redirection allows you to specify a source other than the keyboard for input. And piping combines both input and output redirection so that the screen output from one command is fed into the input of another.

When COMMAND.COM's command parser encounters any of the redirection symbols on the command line, it assumes that you want redirection to occur. Thus, you can't use them in filenames or for any other purpose on the command line other than for initiating input or output redirection or piping.

When it encounters a < operator on the command line, DOS closes the handle that corresponds to standard input and opens the named file or device, allowing it to take over the file handle that formerly was assigned to standard input. Then, when the program or DOS command on the left-hand side of the redirection operator reads from standard input, it unknowingly receives its input from that file or device instead of CON. The same is true when a > operator is detected, except the handle closed and replaced is the one assigned by default to standard output.

OUTPUT REDIRECTION

The general syntax for redirecting output from a DOS command is

```
command > destination
```

where *command* is the command whose output you want redirected and *destination* is the file or device that you want it directed to. The command

```
DIR A: > LPT1
```

sends a directory listing of the disk in drive A: to the printer attached to LPT1. If there is no MODE command in effect routing output from LPT1 to a serial port, the command

```
DIR A: > PRN
```

does the same thing. Figure 1 lists the device drivers DOS installs each time the system is started. You can use any of these as destinations for redirected output. By default, data sent to standard output goes to the screen through CON, so there's no need to redirect output to CON. The one possible exception to this is when standard input and output have been assigned to another device with the CTTY command. In this case, you can still send messages to screen by redirecting output to CON.

The NUL device gives you a convenient means for suppressing message output from DOS commands. Anything written to it simply disappears. If you're running a batch file in which several COPY commands copy files to a RAM disk, and you don't want the "files copied" messages littering the screen, you can redirect output from the COPY commands to NUL. For example, the commands

```
COPY C:\CAD\*.EXE F:\ > NUL
COPY C:\CAD\*.OVL F:\ > NUL
COPY C:\CAD\*.DAT F:\ > NUL
```

copy everything with the extension .EXE, .OVL, and .DAT from the specified directory to drive F:, but do so without displaying the messages that normally accompany the completion of each command. Note, however, that error messages output from DOS commands will still appear on the screen, because they go to the CON device driver through yet another predefined channel called *standard error*.

If the *destination* parameter on the right side of the > operator doesn't name one of DOS's resident device drivers or another character device driver installed in the system with a DEVICE= directive, DOS assumes it's a filename and stores the output of the command in that file. The command

```
DIR A: > DIRLIST.TXT
```

writes a directory listing of A: to the file DIRLIST.TXT. If DIRLIST.TXT doesn't exist, DOS creates it for you. If it does, that file is overwritten by the new one and its original contents are lost. You can have DOS simply append the output to a file by doubling the > operator. For example, the command

```
DIR A: >> DIRLIST.TXT
```

appends the new information to the end of an existing file. Again, if DIRLIST.TXT doesn't already exist, DOS will create it for you.

One of the important things to note about output redirection is that it's only good for capturing and redirecting output destined for the screen. Many new users mistakenly believe that redirection can be used to capture printer output to a file. It can't. Doing so requires a separate utility designed to intercept data transmitted via interrupt 17h (the BIOS printer output interrupt), like *PC Magazine*'s PRN2FILE, which is available on PC MagNet for downloading. If you just remember that DOS restricts you to rerouting data going

SYSTEM DEVICE DRIVERS

Driver	Device represented
NUL	NUL device (mapped to nowhere)
CON	Console device (screen and keyboard)
AUX	Auxiliary device (normally mapped to COM1)
PRN	Printer (normally mapped to LPT1)
COM*x*	Serial port COM*x* (COM1, COM2, COM3, or COM4)
LPT*x*	Parallel port LPT*x* (LPT1, LPT2, or LPT3)
CLOCK$	Real-time clock

Figure 1: DOS installs these device drivers each time the system is started, to provide an interface to the screen, keyboard, real-time clock, serial ports, parallel ports, and printers. Any of them may be named as the source or destination for redirected input or output.

to standard output or coming from standard input, it will always be clear whether redirection applies.

INPUT REDIRECTION

Input redirection is exactly analogous to output redirection, except that it has DOS look to a source other than the keyboard for input. The syntax for redirecting the input to a command is

```
command < source
```

where *source* is the file or device that will provide the input. The *source* parameter, like the destination parameter used in output redirection, may be a filename or any of the device names listed in Figure 1.

The most common use for input redirection is to supply input to DOS commands from text files. For example, the FORMAT command pauses after formatting a disk and asks if you'd like to format another. You must press N to return to the command line. This is an annoyance if you're formatting disks from a batch file and want the batch program to proceed from start to finish without operator intervention. To compensate, you could create a text file containing an N followed by a carriage return (call it NO.TXT) and start FORMAT with the command

```
FORMAT A: < NO.TXT
```

Then, when FORMAT stops for a keystroke, it will get an N from the text file. You can run any DOS command that requires keyboard input by embedding the commands that you'd normally type at the keyboard in a text file and redirecting input to the file. For instance, *PC Magazine* frequently prints DEBUG scripts that create standalone .COM files. Instead of entering these scripts directly in DEBUG, it's much easier to type the same commands into a text file and use input redirection to execute them in DEBUG.

Let's say you want to execute the following DEBUG script to create a utility named KBCLEAR.COM that clears the keyboard buffer of impending keystrokes (a utility that might be useful, for example, to place between programs invoked from batch files to prevent leftover keystrokes in one program from affecting the operation of the next program):

```
A 0100
MOV AX,40
MOV DS,AX
MOV AX,[1A]
MOV [1C],AX
RET

N KBCLEAR.COM
RCX
C
W
Q
```

You could start DEBUG and type the commands exactly as shown. A better way is to create a file called KBCLEAR.SCR that contains these commands, and type

> The most common use for input redirection is to supply input to DOS commands from text files.

```
DEBUG < KBCLEAR.SCR
```

instead. The result? DEBUG executes the commands and creates the .COM file. Even better—if there was a mistake in the commands you entered, you don't have to start DEBUG and type them all over again. Just edit the text file and execute the same DEBUG command again to recompile the utility.

Theoretically, at least, it's also possible to pass input to DOS commands from devices such as serial ports. The command

```
DEBUG < COM1
```

would tell DEBUG to look to COM1 for commands. But it's rare that this type of operation is needed, and rarer still that it is actually performed.

PIPING

Piping combines both input and output redirection into a single operation, capturing the output from one command and supplying it to another as input. The syntax for a piped command is

```
command1 | command2
```

where *command1* is the command whose output is redirected and *command2* is the command that receives the redirected output as input. A common example is the command

```
DIR | MORE
```

which displays the contents of the current directory one screen at a time. How? DIR produces the listing, but the piping operator intercepts the output from DIR and "pipes" it to the MORE.COM utility. (MORE is stored with the other DOS files on your hard disk.) MORE accepts the listing as input and displays it one screen at a time, pausing at the bottom of each screen for you to press a key so the listing doesn't scroll uncontrollably by.

Using the piping operator this way is equivalent to using input and output redirection in two separate operations. For example, you could accomplish the same thing with the commands

```
DIR > TMPFILE.TXT
MORE < TMPFILE.TXT
```

But why do in two steps what you can do in one? Piping eliminates the need to create a temporary file to hold the output from the DIR command.

From a user's perspective, piping differs from input and output redirection in that the object of a redirection operator should be a device name or filename, while the parameter to the right of a piping operator must be a program name. The most frequent beneficiaries of piped input are the three DOS filter commands: FIND, MORE, and SORT. *Filter* is the name for programs that process streams of characters read from standard input and write modified streams out to standard output. Typically, filters have no ability to ask for input on their own, but rely instead on input piped in from other DOS commands (FIND is an exception; unlike MORE and SORT, it can be run as a standalone command). The command

```
DIR | SORT
```

lists the files in the current directory sorted by filename, while the command

```
DIR | SORT /+13
```

lists them sorted by file size. (The 13 tells SORT to arrange the directory listing based on the characters in column 13 of your display—where the file size is indicated). You can combine multiple piping operators (and redirection operators, too) on a single line to further modify the output of DOS commands. The command

```
DIR | SORT /+13 | MORE
```

lists files in order of increasing length *and* displays them one screen at a time. As you can see, the possibilities are nearly endless.

You can create filter commands of your own if you program in C or assembler or any other language that lets you read from standard input and write to standard output. Chapter 13 of Ray Duncan's book *Advanced MS-DOS*, published by Microsoft Press, contains an excellent discussion of how filters work and how they're written.

WHY REDIRECTION DOESN'T ALWAYS WORK

To beginning users, one of DOS's great mysteries is when redirection will work and when it won't. It does work with DOS commands and with a number of command line utilities, but it doesn't work if you try to capture output from applications such as *Lotus 1-2-3* and *WordPerfect*. Understanding how DOS programs write to the screen and read the keyboard will help you understand just why redirection sometimes works and sometimes doesn't.

DOS applications employ a number of methods for writing text to the screen. They can use any of the several character output services DOS provides, they can use routines built into the video BIOS, or they can write data directly to the video buffer. The advantage of direct writes is that they're fast, while the BIOS offers a reasonable compromise between speed and ease of coding. DOS's character output services, meanwhile, are comparatively slow, so very few programs other than command line utilities use them. Similarly, most programs use the interrupt 16h services in the BIOS for reading the keyboard rather than the keyboard services DOS provides. The key to predicting whether redirection will work is knowing that only programs using DOS services to perform input and output are candidates for redirection.

Here's an example illustrating the difference. The following DEBUG listing creates HELLO1.COM, a little program that writes "Hello, world" to the screen using DOS's interrupt 21h, function 09h character output service:

```
A 0100
JMP 010F
DB "Hello, world$"
MOV AH,9
MOV DX,0102
INT 21
RET

N HELLO1.COM
RCX
17
W
Q
```

Once HELLO1 is compiled, typing

```
HELLO1 > HELLO.TXT
```

creates a text file containing the string "Hello, world." Now, enter:

> One of DOS's great mysteries is when redirection will work and when it won't.

```
A 0100
JMP 010F
DB "Hello, world$"
CLD
MOV SI,0102
LODSB
CMP AL,24
JZ 011E
MOV AH,0E
INT 10
JMP 0113
RET

N HELLO2.COM
RCX
1F
W
Q
```

This DEBUG listing creates a second program called HELLO2.COM. HELLO2 does the same thing HELLO1 does, but in a different way. Rather than use DOS to display "Hello, world," HELLO2 uses interrupt 10h, function 0Eh, which is contained in the BIOS. Now see what happens when you try to redirect output from HELLO2 with the command

```
HELLO2 > HELLO.TXT
```

DOS will create a file named HELLO.TXT, but there will be nothing in it. Furthermore, "Hello, world" will appear on the screen even though you attempted to redirect it to a file. What happened? The answer is simple. Because HELLO2 uses a BIOS output routine instead of a DOS output routine, DOS didn't even know that the message was being written to the screen. And since it didn't know about the message, it couldn't very well capture the output to a file.

A final note about redirection concerns TSRs. Attempting to redirect output from terminate-and-stay-resident programs rarely works, because very few TSRs use DOS's console I/O functions for screen output. But there's a potentially more serious drawback. Redirecting output from a TSR ties up one file handle *permanently*, because DOS closes only the handle used for redirected input or output when the application quits. And by definition, a TSR never really quits. This could affect the rest of the system if another program needs a file handle and can't get it because DOS has already allocated as many as it can.

Knowing how to put redirection and piping to work is one step toward making better, more efficient use of your system. And once you know how to use them, it's really not as difficult to put them to work as it may have seemed when you first encountered them.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. To have your question answered, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see the PC MagNet News page, immediately following the Utilities column, for access instructions). We're sorry, but we're unable to answer questions individually. ■

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by
Frank J. Derfler, Jr.

Connectivity

- WHAT'S IN A NAME: Unix filenames can look very strange on a PC!
- BAD CONNECTIONS: Are type 66 punch-down blocks dangerous to your network's health?
- USING DBASE III PLUS ON A NETWORK: A couple of quirks make *dBASE* tricky to use on a LAN.
- OVERLAY DELAY: Performance suffers when many users try to access overlay files on a server. Here's how to speed things up.
- SECURING YOUR DATA: A clever trick to keep users from downloading data onto floppies.
- ROUTING FAXES: Here's a product that let's you route incoming faxes to the right user.

WHAT'S IN A NAME?

Some of the files on my Sun computer running the NFS file server program don't show their correct names when I use the DIR command on my PC running PC-NFS. For example, I have a file named Readme whose name appears in the subdirectory listing as READM~AA, and another file named foo.txt.old which appears as FOO~T~AI.OLD. While I can successfully access the files using those funny names, I can't access them by their correct names. What's going on?

Bill Larson
Fargo, North Dakota

This is a common problem people encounter when they use any type of non-DOS server, including Macintosh, DEC, Sun, and others. The software running in the PC tries to maintain compatibility by interpreting the differences between the DOS file naming conventions and those used by the other operating system.

In general, DOS file naming conventions are more restrictive than the others. We're all familiar with the DOS 8-and-3 character format and that even if you type filenames in lowercase, DOS always lists them in uppercase. Many other operating systems are less restrictive; accepting filenames with both upper- and lowercase letters, longer groups of letters, and even more than one period.

As a result, software in the PC, like *PC-NFS*, must translate between DOS filenames and the more-complex configurations. The translation rules get pretty complex, but generally the tilde (~) character shows dropped characters. The only way around the problem I know of is to follow the DOS file naming conventions, no matter which system you're using.

BAD CONNECTIONS

I don't agree with your statement in the October 16, 1990, issue that refers to type 66 punch-down blocks as the "central failure points in wiring plants" (Building Workgroup Solutions: 10BaseT LANS). As a manufacturer of telecommunications wiring hardware, including type 66 blocks, I feel you should know that we have thoroughly characterized their transmission capabilities and have found them to meet all applicable test requirements for level 1 performance when tested in accordance with EIA/TIA draft specification SP-1907B. This specification is scheduled for release as EIA/TIA-568.

The data-worthiness of type 66 connections in the field is supported by the fact that IBM has standardized on type 66 blocks for Token-Ring over unshielded twisted-pair wiring.

However, you do raise a good point on the poor suitability of many telco (telephone company) installed wiring plants for data circuits—particularly those with untwisted cable pairs and antiquated insulation materials. Considering the longevity of type 66 connections, it's more than just a coincidence that old telephone cables—which typically have detrimental effects on data transmission—are often wired with type 66 blocks.

John A. Siemon
Vice President of Engineering
The Siemon Company

Maybe I am condemning type 66 blocks by their association with older, poorly installed wiring plants, but when I wiggle the wires at the punch-down block and can see the noise on a scope or hear it in the phone, I suspect that the system will not be able to support data over any period of time. My experience shows that a lot of twisted-pair wiring plants, installed by telcos or by private contractors, need careful testing and reworking before they can be trusted to carry data.

USING DBASE III PLUS ON A NETWORK

Until recently, only one person in our company has been working with our customer database. Now, we'd like to share that database among several users. There's one possible problem, however: The database uses *dBASE III Plus*. We've been told that *dBASE* requires NetBIOS, and our *PC-NFS* network doesn't include a NetBIOS emulation.

Steve Alpert
Boston, Massachusetts

dBASE uses normal DOS 3.1 file sharing and record locking and doesn't use any special NetBIOS functions. But it does use a couple of tricks. First, it checks to see if it's running

on a network by issuing an IBM PC Network installation check. This is an undocumented interrupt 2Fh call. If *dBASE* finds that it is running on a network, it only locks files on remote devices, which it identifies using the DOS 5F02 redirection list query instead of using the standard DOS 4409h. What this means is that *dBASE III Plus* won't run properly on network operating systems that don't respond to 2Fh calls. Sun Microsystems tells us that this call was added to *PC-NFS* in Release 3.0.1.

There's another possible difficulty: PC-DOS and MS-DOS differ in the way they handle embedded spaces in filenames. Normally, this doesn't matter, but *dBASE* actually uses such files. To avoid any problems, be sure to add the /S switch to the PCNFS.SYS line in your CONFIG.SYS file, in order to turn on the space-sensitivity mode.

OVERLAY DELAY

We have over 75 heavy users of *WordPerfect* 5.0 on our network. Many complain that *WordPerfect* performs very slowly on the network compared with using it on a standalone PC, especially when overlays are used. Our *WordPerfect* dealer suggests that we load the overlay files into extended memory on as many stations as possible, to reduce the number of stations relying on the file server for access to the overlay, but we already use the extended memory for other things. I suppose we could install the program at the individual workstations as a standalone application, but loading applications on local stations seems like a step backward. Do you have any ideas?

Paul Merritt
San Diego, California

When people access *WordPerfect* functions such as Spell Check (Ctrl-F2) or List Files (F5), the program goes to a 600K overlay file in the file server, finds the right segment of the file, and brings in the code it needs to perform the function. *WordPerfect* 5.1 adds enhanced tables and the Equation Editor, which make even more calls to the overlay files. When you have lots of users processing lots of words, network traffic is heavy and performance suffers, particularly if the overlay file isn't cached in the server. By the way, this isn't just a problem with *WordPerfect*. Almost all word processing programs that attempt to limit the RAM they use make extensive use of overlays.

If you don't want to load the entire application on each PC, you can load just the overlay files on as many stations as possible. LANSmith makes a product called *Net-Aware*, which will route requests for access to the overlays to the local hard disk instead of sending them to the server. *Net-Aware* uses rules you establish to literally redirect the redirector so specific requests for data are met from locations you specify. This does a lot to cut out the excessive traffic over the network. For more information about *Net-Aware*, call LANSmith at 800-522-4567.

SECURING YOUR DATA

We were concerned about people copying programs and data from our Novell network onto floppy disks, but since some users have a legitimate need to use floppies, we didn't want to remove the drives from our PCs. To prevent unauthorized users from downloading data to local drives, we came up with the following trick.

First, we relocated MAP.EXE to a separate directory that only the supervisor can access. In this way, no one but the supervisor can remap drives.

Then, in the system login script, we remapped all the local drives to a network subdirectory called DUMP, using the following statements:

```
MAP A: = SYS:\DUMP
MAP B: = SYS:\DUMP
```

When anyone needs access to the local drives, the system administrator remaps them with the MAP DEL command. You simply type MAP DEL A: and the drive reverts to its local mapping.

Malvin Loefstop
Oranjestad, Aruba

Your hint produces a poor man's diskless workstation very easily. I've also seen system administrators change the MAP.EXE file to some other filename with an .EXE extension. It takes a pretty determined crook to find and use the renamed MAP file.

ROUTING FAXES

I've commented several times on the problems involved with using a networked fax server to receive incoming messages. Specifically, someone must go to the trouble of reading every received fax image file to determine who should get it. While I still think that the problems of viewing fax images make them more trouble than they are usually worth, I recently saw a product that at least eliminated the routing problem.

A company called Cracchiolo & Feder (602-327-1357) markets a program called *RightFAX*, which works with Brooktrout Technology's TR-112 series of fax cards. *RightFAX* can route fax images over the network to their correct destinations.

RightFAX reads the last four digits of the recipient phone number and routes the fax image based on those digits. This way you can assign a unique phone number to each network user and eliminate the human factor. The software also provides a log of incoming and outgoing faxes, mailbox security, signatures and letterhead overlays, and other features. On the outbound side, the software emulates a network printer, making it easy for people to prepare faxes with many different kinds of application programs.

RightFAX was designed to work in DOS and OS/2 client PCs. A recent release of the server software runs on any OS/2 machine along with *LAN Manager* or other OS/2 applications.

Your organization can make the best use of this system if you have a PBX—you'll be able to share the circuits going to the telephone company's central office, and you won't have to order more lines. You will need a dedicated AT-class machine to act as the fax server on *NetWare* and all networks other than *LAN Manager*.

This is not an inexpensive system. The software retails for $1,495 for the basic package, which is able to service two incoming lines. You can add two additional lines at a time with a separate module selling for $495.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tip we print. Please submit your letter on a disk along with a printout. Then mail your contribution to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named PC MAGAZINE LAN LABS). We are unable to answer letters individually. ■

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- ✓ 4 megabytes high speed RAM.
- ✓ 100 mb 20ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" and 1.44mb 3.5" floppy drives.
- ✓ Full size (shown) or standard size chassis with keylock and reset buttons.
- ✓ 387-DX coprocessor socket.
- ✓ 230 watt power supply.
- ✓ 14" Super VGA color monitor, 1024x768 resolution, with 16 bit VGA card with 1mb Video Ram.
- ✓ Clock calendar, parallel port, game port and two serial ports.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots & 5 drive bays.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ FCC Class B approved.

386/33	80 IDE	100 IDE	200 IDE	330 ESDI
Mono	$2,009	$2,089	$2,399	$3,159
VGA White	$2,109	$2,189	$2,499	$3,259
VGA Color	$2,259	$2,339	$2,649	$3,409
VGA 1024	$2,319	$2,399	$2,709	$3,469

FastData 386/25 $1999

The optimum combination of features, expandability, and power make the FastData 386/25 an ideal choice for those whose applications demand high speed 32 bit processing and expandability. The value of the 386/25 goes far beyond its price; it comes configured with a a full four megabytes of fast RAM, a quick 22 millisecond 65 megabyte hard disk, and maximum VGA displaying 1024 by 768 resolution powered by a high-output 16 bit 512K VGA board. Also, the FastMicro team will configure your FastData 386 exactly the way you want, without sending you shopping elsewhere.

Standard Features

- ✓ 25mhz Intel 80386-DX.
- ✓ 4 megabytes of high speed RAM.
- ✓ 80 mb 20ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. (For both add $69)
- ✓ Standard chassis (shown on left) with keylock, speed and reset buttons.
- ✓ 80387-DX coprocessor socket.
- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor, 1024x768 resolution, with 16 bit VGA card with 1mb Video Ram.
- ✓ Clock calendar, parallel port, two serial ports, and game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots & 5 drive bays.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ FCC Class B approved.

386/25	40 IDE	80 IDE	100 IDE	200 IDE
Mono	$1,539	$1,689	$1,769	$2,079
VGA White	$1,639	$1,789	$1,869	$2,179
VGA Color	$1,789	$1,939	$2,019	$2,329
VGA 1024	$1,849	$1,999	$2,079	$2,389

FastData 486/25

Call about our hot 486, just $3,099 with the same standard features as our 386-33 system. Includes a 128K two-stage cache and is expandable to 64mb of memory.

All FastData Systems Include:

- 30 day money- back guarantee
- Toll-free technical support for life
- One year warrantee with on-site service available to most U.S. locations

FastData SX Systems

$1599 FastData SX/20

25% faster than a 16mhz SX, the FastData SX/20 adds even greater performance to its 386 multitasking capabilities. Just $200 more than our SX/16, this machine also includes a second floppy drive in addition to the standard VGA color monitor and 16 bit VGA adaptor, Keytronics keyboard and 40 megabyte hard drive. The system includes two megabytes of memory and is expandable to eight on the main system board. Remember, when you have questions, need to solve a problem, or want recommendations on products for your system, the FastMicro team is standing by toll-free to provide product support for as long as you own your FastData personal computer.

Standard Features

- ✓ 20mhz Intel 80386-SX processor.
- ✓ 2 megabytes of high speed RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" and 1.44mb 3.5" floppy drives.
- ✓ Standard chassis (shown) with keylock, speed and reset buttons.
- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor with 16 bit VGA card with 512K.
- ✓ Clock calendar, parallel port, two serial ports, and game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ Guaranteed compatible.
- ✓ FCC Class B approved.

SX/20	40 IDE	80 IDE	100 IDE	200 IDE
Mono	$1,289	$1,439	$1,519	$1,829
VGA White	$1,389	$1,539	$1,619	$1,929
VGA Color	$1,539	$1,689	$1,769	$2,079
VGA 1024	$1,599	$1,749	$1,829	$2,139

$1399 FastData 386/SX

Combine the benefits of an advanced Intel 386 processor, the value of a 286 and the advantages of FastData and you've got the FastData 386/SX! This machine is the choice of those who want to run today's powerful 386 and multitasking software, like Windows, and also want to run their favorite DOS applications at surprising speeds. We've made our customers' favorite options standard: it comes with an ample two megabytes of memory, a high performance 40mb hard drive, and 16 bit color VGA. Compare performance, features, and service and you will find no better SX value. Interested further? Try the FastData 386/SX for 30 days; you have to be happy - if not, we'll take it back.

Standard Features

- ✓ 16mhz Intel 80386-SX processor.
- ✓ 2 megabytes of high speed RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. Both add $69.
- ✓ Standard chassis with keylock, speed and reset buttons (mini desktop shown - add $50).
- ✓ 200 watt power supply
- ✓ 14" VGA color monitor with 16 bit VGA card with 256K.
- ✓ Clock calendar, parallel port, two serial ports, and a game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ Guaranteed compatible.
- ✓ FCC Class B approved.

386/SX	40 IDE	80 IDE	100 IDE	200 IDE
Mono	$1,149	$1,299	$1,379	$1,689
VGA White	$1,249	$1,399	$1,479	$1,789
VGA Color	$1,399	$1,549	$1,629	$1,939
VGA 1024	$1,459	$1,609	$1,689	$1,999

FASTMICRO

For information or to order call:

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CIRCLE 352 ON READER SERVICE CARD

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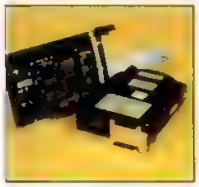
1-800-441-FAST

Hardware

DISK DRIVES

Colorado DJ-10 40-120mb Int. Tape	249
DJ-20 80-240mb Int. Tape	319
Conner *(see IDE controllers below)*	
CP3044 40mb IDE 28ms	269
CP3104 100mb IDE 25ms	499
CP3208 200mb IDE 25ms	849



Seagate 89mb AT Kit $399

IDE performance, big 89 megabyte capacity and Seagate quality make this kit a great buy. A 19ms access time and 5 mbps transfer rate assure great performance. Controller cables and rails are included to make installation fast and easy.

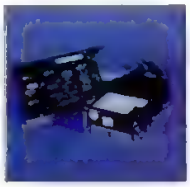
Micropolis	
MC1664 340mb ESDI 14ms	1295
MC1598 1.2gb SCSI 14ms	2895
NEC CDR-3501 Ext. CD-ROM w/interface	549
Plus Development	
HardCard IIXL 50 - 52mb 9 ms 16bit	399
HardCard IIXL 105 - 105mb 9 ms 16bit	679
Impulse 42mb 12 ms 16bit IDE Kit	399
Impulse 105mb 9 ms 16bit IDE Kit	599

Toshiba 1.44mb Floppy Drive $69

Complete with mounting brackets and installation instructions, this Toshiba works in all true 286 & 386 compatibles. Will also read/write/format 720K 3.5 disks. Rails, add $5.

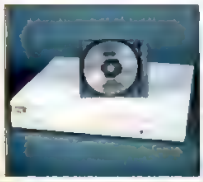
Seagate	
30MB XT Kit ST238 w/ cont	249
40MB AT ST251-1 MFM Drive	239
40MB AT ST157A 28ms IDE Drive	199
80MB AT ST296N SCSI Drive w/adaptor	349
89MB ST1102A 19ms IDE Drive	359
125MB ST1144A 19ms IDE Drive	469
210MB ST1239A 15ms IDE Drive	799
330MB ST2383E 16ms ESDI Drive	1289
Teac	
1.2MB 5.25" Floppy	65
1.44MB 3.5" Floppy	65

Toshiba 100mb IDE Kit $489



Upgrade your 286 or 386 to IDE technology and Toshiba quality at a FastMicro price. This kit comes with a fast 20ms 105mb drive and built-in 1:1 controller, 16 bit IDE card with dual floppy controller and cables, 5.25" brackets and rails. Call our experts for all your drive needs. Model MK234FC

Toshiba	
360K 5.25" Floppy (Black)	69
1.2MB 5.25" Floppy	69
1.44MB 3.5" Floppy	69
65mb MK134 22ms RLL drive	279
100mb MK234FC IDE 3.5" drive	449
Western Digital	
WD 16 bit IDE Host - with dual floppy controller	39
WD93044 40mb IDE 28ms	199
WDAC280 80mb IDE 28ms	339
WE1007V-SE2 ESDI AT 1:1 dual controller	149



Sun Moon Star CD-ROM Drive $549

Affordable CD-ROM technology is here! This player reads over 600mbs from just one CD and can even play your favorite audio CDs. Using a high quality Hitachi mechanism, it comes with a cable, interface and 18 month warrantee. Add an Illustrated Encyclopedia CD for $49.

BOARDS

Artisoft/Lantastic	
Lantastic 2mbps Starter Kit - Two Station	369
Lantastic 2mbps Adaptor	169
Lantastic Ethernet Starter Kit - Two Station	499
Lantastic Ethernet Adaptor	239

ATI VGA Wonder + $189

New and improved, the ATI VGA WONDER+ is faster than VRAM. It does interlaced and non-interlaced 1024x768 modes is 100% register compatible, and comes with extensive software drivers. A free mouse is included as an added bonus. 512K version $219.

ATI	
2400 ETC Internal	Call
2400 ETC External	187
9600/E External MNP V.42bis	479
VGA Basic 16	75
VGA Wonder + 256K	189
VGA Wonder + 512K	229
Brown Wagh Sound Blaster	149
Everex	
2400B Int Modem	99
EGA 480 Card	69
RAM3000 16 bit RAM card	75
RAM8000 16 bit RAM card	169
Hayes	
JT FAX 4800B Internal	139
Personal Modem 2400 w/Prodigy	119
Hercules Graphic Card +	169
Intel	
Classic 2400 Modem Int./Ext.	137/167
Satisfaxtion Classic - Internal 9600	379
8087-2	115
287XL	199
387-DX25	479
387-SX16/20	319/349
Logitech	
ScanMan Plus	165
Scanman 256	289
Orchid	
ProDesigner II 512/1mb	279/329
Tiny Turbo 286	207
Tiny Turbo Xtra	267

[illegible] Modem $449

This external modem features V.42 and MNP error correction combined with MNP/5 and V.42 bis data compression to provide total high speed throughput. The PM9600SA is also V.32 TCM, V.32, V.22 compliant and comes with a five year guarantee.

Paradise	
Basic VGA - 8 bit	109
VGA 1024 256K/512K	175/199
Practical Peripherals	
2400B Int Modem	125
2400B Int with MNP	169
PM9600SA Ext V.32/V.42bis	449
Prometheus	
Promodem 2400B Internal	98
Promodem 2400G External	149
USRobotics	
2400 Sportster Int/Ext.	119/147
2400 Sportster Int/Ext.	159/199
Courier HST 14,400 Int Ext	539/579
Courier HST 14,400 Dual Standard Ext.	859
Video 7	
VGA 1024i 256K	179
VGA 1024i 512K	209
V-RAM VGA 512K	299
ZOOM	
HC2400 Internal	79
2400 V.42bis External Modem	169
9624 Send/Receive Internal Fax Modem	129

MONITORS

Mitsubishi	
1410 EGA	325
Diamond Scan 1381	479
NEC	
Multisync 2a	469
Multisync GS 2a	199
Multisync 3d	629
Multisync 4d	Call
Panasonic C1381 VGA	439
Princeton	Call
Seiko CM1440/1450	519/659
Sony 1304 Multiscan	669
Zenith 1492	Call

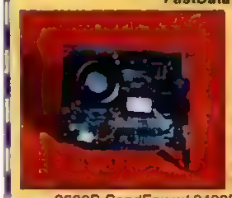
FastData Products

FastData 16 Bit VGA

The FastData 16bit VGA card features 256K of video memory, does CGA, EGA, & VGA up to 1024x768 and comes with drivers for popular software including Windows 3.0. It's expandable to 512K and has a 30 day money-back guarantee. $89 256K Ver. $119 512K Vers.

FastData 16bit 1mb VGA	159
FastData CGA Card	35
FastData MGP Card	29

FastData 2400 Baud Internal Modem



$69 The FastData 2400 baud internal modem is fully Hayes compatible and can be configured to COM port 1-4. It has an internal speaker, is auto answer & auto dial, and comes with BitCom software.

9600B SendFax w/ 2400B Modem	99
MFM 16 Bit 1:1 Hard/Floppy Disk Cont.	59
Parallel/Dual Serial/Game Card	29
RLL 16bit 1:1 Hard/Floppy Disk Cont	69
XT 1.44 Dual Floppy Controller	35

FastData Monitors

Your best value, we have a complete line made for us by leading manufacturers like Samsung & Hyundai. Like all FastData products, you have a full 30 day money back guarantee. Shown is the VGA Color for $279.

FastData Monitors	
12" Amber Monochrome	79
14" Amber Monochrome	109
14" White Monochrome	109
14" White VGA Monochrome	129
14" CGA Color .52 dot pitch	199
14" VGA Color .39 dot pitch	269
14" VGA Color .31 dot pitch	319
14" Super VGA 1024 x 768i 28 dp	349

PRINTERS

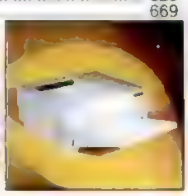
Canon BJ10E	319
BJ300/BJ330	495/Call

Citizen GSX140 $285

Loaded with features, this 24 pin printer is a hot seller! It comes with 6 resident fonts, paper parking, and Epson & IBM printing modes. It does up to 192 CPS and has a unique LCD control panel that lets you set everything without DIP switches. Upgrade to color anytime for just $39.

Citizen	
200GX	189
GSX140 / GSX145	285/395
Fujitsu DL3400	359
NEC	
P3200	269
P3300	369
P6200	469
P6300	629
OKIDATA Okilaser 400	669

NEC Silentwriter 2 Model 90 $1595



PC Magazine's editor's choice! The new NEC model 90 comes with 2mb of memory, Postscript by Adobe with 35 fonts, and parallel, serial and Appletalk interfaces. All this and 6 ppm speed, an easy to use LCD operator panel and letter, legal, & envelope feed.

Panasonic	
KXP1180	155
KXP1123	Call
KXP1624	429
KXP4420 Laser	829
KXP4450/4455 Lasers	Call
Seiko Smart Label Printer	167
Star	
NX1001	149
NX1500	299
NX2410	249
XB2410 / 2415	429 / 569
Texas Instruments Microlaser PS17	1199
Microlaser PS35	1499

FastData 286/12 $799

Imagine a fast 286 computer at a super price and you've got the FastData 286/12. This system is complete, not stripped. You get one megabyte of zero-wait-state memory and a 28ms IDE hard disk - standard. Also included is an amber monitor and graphics card, your choice of a high density 1.2mb or 1.44mb floppy drive and a Keytronics keyboard. And since its a FastData, you are backed with toll-free technical support, one year warranty with the FastShip replacement program & on-site service plan, and our 30 day full money back satisfaction guarantee!

- ✓ 12mhz 80286 processor.
- ✓ 1 megabyte RAM.
- ✓ 40 mb 28ms hard disk 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive (2nd drive add $69)
- ✓ Standard chassis
- ✓ Five drive bays.
- ✓ 200 watt power supply.
- ✓ *287XL* coprocessor socket
- ✓ Monochrome monitor with monochrome graphic board.
- ✓ Clock calendar, parallel port, and two serial ports.
- ✓ Keytronics enhanced 101 keyboard.
- ✓ 8 expansion slots, 6 available.
- ✓ Full documentation.
- ✓ FCC Class B approved.

System Price	40mb	65mb	80mb	1.1Gigb
Monochrome	$[illegible]	$[illegible]	$[illegible]	$[illegible]
VGA Color	$[illegible]	$[illegible]	$[illegible]	$[illegible]
VGA 1024	$[illegible]	$[illegible]	$[illegible]	$[illegible]

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Software

DATABASE & FORMS

askSam 5.0	209
Avery List & Mail Plus	37
Clanon Personal Developer	45
Clanon Professional Developer	449
Clipper 5.0	489
DataEase	459

Personal R:Base $89

When says powerful relational database is expensive. Not with the new easy-to-use Personal R:Base. It has intuitive, full menus, clear and easy query, your data, build quick forms and reports automatically and even build applications without complex programming.

dBase III+	439
dBase IV	479
dBXL Diamond	129
Formbase	299
FormTool Gold	52
Formfiller	85
Foxbase Plus	177
FoxPro	417
Paradox 3.5	489
Per:Form Designer & Filler	95
Personal Rbase	89
Q & A	214
RapidFile	99
Rbase for DOS	447
Reflex	159

DESKTOP PUBLISHING

Adobe Postscript Cart. for HPLJ-II	279
db Publisher Professional	389
GEM Desktop Pub	159
Pagemaker 4.0	489

Corel Draw Version 2.0 $359

Winner of all the top awards. Corel Draw gives you more for your money. It runs under Windows & includes incredible drawing and editing tools. Includes over 150 typefaces and 500 pieces of clipart. Corel Trace converts scanned art to smooth vector images in seconds. This is the most complete illustration package we've ever seen!

PFS First Publisher	89
Printshop	33
Publisher's Paintbrush	149
Publish It!	135
Ventura Publisher Gold / Windows	539

FINANCIAL

ACCPAC BPI Value Pak	359
Bedford Integrated Acct	119
DAC Accounting 4.1	79
DAC Bonus Pack 4.1	119
DAC Payroll 4.1	57
Dollars & Sense	98

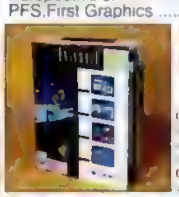
Peachtree Complete III $139

A super value! Includes General Ledger, Accts. Payable, Accts. Receivable, Invoicing, Purchase Order, Payroll, Inventory, Job Cost, Fixed Assets. Comes with over 250 reports, automatic backup and helpful wizards.

Macintax 1040 for Windows	57
Managing Your Money	125
Money Matters	49
One Write Plus G/L, A/P & A/R	165
Peachtree Complete III	139
Peachtree with Data Query	209
Quicken	36
Taxview 1040 Prof. for Windows	299
Turbo Tax Personal 1040	39
Turbo Tax Professional	209
Wealth Builder	129

GRAPHICS

Autosketch 3.0	139
Corel Draw 2.0	359
Design CADD 3-D	185
DrawPerfect	265
Freelance Plus	307
Generic 3D Drafting	199
Generic Cadd Level 2 Starter Kit	95
Generic Cadd 5.0	279
Harvard Graphics	299
PC Paintbrush IV Plus	109
Perspective Jr	69
PFS.First Graphics	89



$115

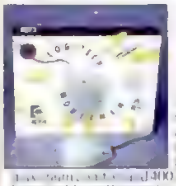
GeoWorks is the entry-level graphical environment that received rave reviews. Includes GeoWrite word processor & desktop publisher, GeoDraw, GeoCalc, GeoFile, GeoPlanner and GeoDex applications. Plus all programs operate with the same point & click simplicity one-time required.

INTEGRATED

First Choice	95
Framework XE	95
Geoworks Ensemble	115
LotusWorks	89
SmartWare II	417
Symphony 2.2	489
Works	89

MICE/INPUT

Keytronics KB101 Keyboard	59
Keytronics Professional Mouse	59
Logitech Mouseman Serial right hand	65
Logitech Mouseman Serial w/Windows	127
Logitech Mouseman Bus right hand	76



Logitech Mouseman Serial $65

Logitech's MouseMan is the next step in mouse evolution. Specifically tailored to right or left hand versions, it provides [illegible] and 400 DPI hardware resolution. Includes MouseWare utilities and Lifetime Warranty. Specify right or left, for PaintShow add $5.

Logitech Mouseman Cordless	129
Logitech Trackman Serial	75
Microsoft Serial or Bus Mouse only	83
Microsoft Serial or Bus w/ paint	95
Microsoft with Windows 3.0	147
Z-Nix Serial Mouse w/Windows 3.0	89

PROGRAMMING

Macro Assembler	89
Microsoft C Compiler	303
Borland C++	129
Turbo Pascal	90
Quick Basic	60
Quick C	60
Quick Pascal	60
Windows Developer's Kit	309

SPREADSHEETS

Allways	115
Excel for Windows	299
Lotus 1-2-3 version 2.2	325
Lotus 1-2-3 version 3.1	399

Excel 3.0 for Windows $299

The best graphical spreadsheet now. Includes Toolbar which puts frequently used commands at single mouse click away. New Q + E lets you access remote databases & Best Fit automatically resizes contents to display longer cell widths. 3-D charts, clip art support, and button macros are included too! Command level on-screen help for transitional 1-2-3 users is included too.

Lucid 3-D	53
Quattro Pro 2.0 Competitive Upgrade	89
Supercalc 5D	289

WORD PROCESSORS

Facelift for WordPerfect	57
Grammatik IV	49
LetterPerfect	119
Multimate 4.0	267
Professional Write	119
Publisher's PowerPak for WordPerfect	45
Rightwriter	58

WordPerfect 5.1 $239

WordPerfect is the #1 rated word processing software. Its got almost every feature imaginable and yet it is easy to use. The current version adds roll-down menus, mouse support, table creation and editing, sorter. Add this to its best software support in the business and you can't go wrong!

Sprint	117
Word	209
Word for Windows	309
Word Perfect 5.1	239
Word Perfect for Windows	Call
Word Perfect Add'l Station	153
Word Perfect Office	79
WordStar Professional	Call
Writer's Toolkit	79

Call On Non-Listed Items

WINDOWS SOFTWARE

Adobe Illustrator	279
Adobe Type Manager	59
Ami	115
Ami Professional	287
Asymetrix Toolbook	279
Bitstream Facelift	57
Corel Draw 2.0	359

Windows 3.0 $89

Turn your 286 or above with 640K or more of memory into a powerful multitasking workstation that runs even non-Windows applications. Includes many in-a-grand applications standard. Plus, if you buy Windows now from FastMicro we'll throw in 10 of the best Windows shareware programs.

DBfast Windows	239
Excel	309
Form Publisher	139
Grammatik IV for Windows	49
HDC First Apps or Windows Express	46
Micrographix Draw +	149
Micrographix Designer	449
MicroPhone II	199
Microsoft Mouse w/ Windows 3.0	147
Microsoft Office (Word/Excel/Powerpoint)	619
Microsoft Productivity Pack	39
Microsoft Windows Developer's Kit	309
Pagemaker 4.0	489
Per Form Pro	289
Powerpoint for Windows	309
Project for Windows	429
Publisher's Powerpak for Windows	45
Windows 3.0	89
Windows Entertainment Pack	27
WingZ Spreadsheet	309
Word for Windows	299

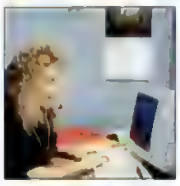
Adobe Type Manager & Type Align $109 for both

Adobe Type Manager for Windows brings scalable PostScript fonts to your screen and non-PostScript printer or laser printer. Includes Times, Helvetica, Courier and Symbol font families. New Adobe Type Align for Windows works with ATM to create curved, skewed and other special type effects which you can import into other Windows applications.

ENTERTAINMENT & EDUCATION

Bannermania	21
Carmen SanDiego Deluxe Edition	45
F-19 Stealth Fighter	38
Hunt for Red October	19
King's Quest 5 (VGA Vers.)	38
Leisure Suit Larry II or III	35
Microsoft Flight Simulator	38
Aircraft & Scenery Designer	27
Microsoft Learning DOS	32
NFL Challenge	55
PC Globe or PC USA	35
Simcity	28
Tetris	19

FASTMICRO



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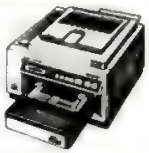

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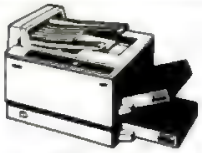

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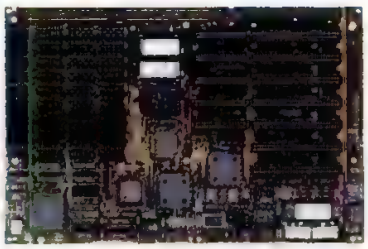

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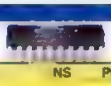

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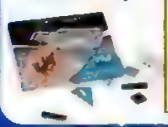

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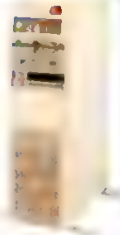

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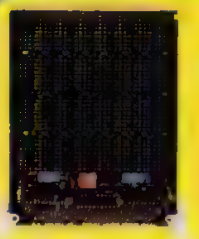

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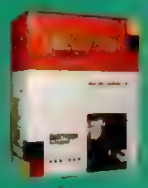

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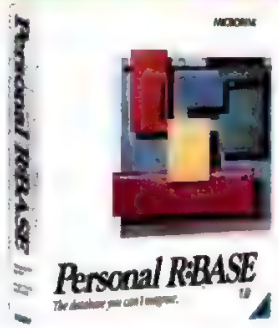

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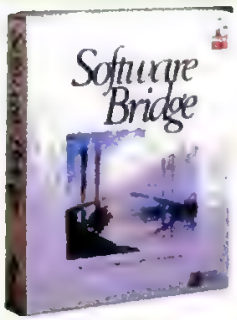

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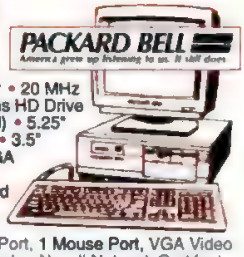

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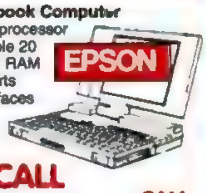

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by
Joe Salemi

Advisor

Help for Readers Making Personal Computer Decisions

- MARKETING SHAREWARE: How you can sell a program you've written with only a minimal investment.
- COPROCESSORS AND GUIs: Does a math coprocessor improve the speed of *Windows* or OS/2?
- PRN AND OTHER GHOSTLY FILENAMES: Why those odd filenames are found on all your disks.

MARKETING SHAREWARE

I have recently written a game program that I think is pretty good.

What do I have to do in order to make the game shareware, so I can get some benefit out of it?

Gary Wu
Poway, California

Before discussing how to market a program as shareware, I'd like to first make sure we agree on what shareware is.

Since the early days of microcomputers, there has been an alternative to the commercial method of distributing software. Many programmers wrote utilities, games, and applications that they thought were useful, and wanted to share them with others, but they didn't have the time or resources to devote to marketing the software as a commercial product.

At first, these programs were distributed on disks at user group meetings; with the advent of BBSs, the programmers discovered a means of electronically distributing their software to a wider audience.

There are three types of software distributed this way—public domain, copyrighted-but-free, and shareware.

Public domain: If you call your software public domain, you give up all your rights to it; others can feel free to use and modify it as they see fit, and distribute their version as their own. If someone decides to sell the software to others who aren't aware of the original sources, there's nothing you can do to stop it.

Copyrighted-but-free: is an alternative to public domain software. It means that you, as author, retain all copyrights to the program, but you don't charge others for its use, and they can use it for as long as they like. *PC Magazine* utilities are an example of copyrighted-but-free software.

Shareware: is copyrighted software that is distributed with a limited-use license. The user is free to evaluate the software for his or her own use for a period of time (usually 30 days); if he decides that the package is of value, then he must register the software by paying the appropriate fee. Otherwise, the user is obliged to stop using the program, and delete his copy. Generally, the shareware authors also encourage users to pass on their copies to others to evaluate (usually through on-line services), so long as the original software package is intact and unmodified, so that the recipient can see the information on how to pay for the software. A number of mail-order vendors also distribute shareware programs on-disk for people who don't have access to a modem. The same rules apply: The recipient is supposed to pay the author for the right to continue using the software.

Shareware programs are no different than the commercial applications that you can buy in the store; they must be paid for if you're going to use them. The registration fee is usually much lower than the cost of an equivalent commercial package, as the packaging and distribution overhead don't exist. This doesn't imply that shareware programs aren't as good as their commercial counterparts, though; most shareware programs are professionally written, and rival commercial programs in power and functionality.

Like a commercial package, the user can expect that the program will be supported by the author. If you release a program as shareware, you must be prepared to provide technical help, bug fixes, and perhaps even newer versions.

The best source for information on marketing shareware programs is The Association of Shareware Professionals (ASP). The ASP has developed a set of standards for what a shareware program is, how it should be supported, and how disagreements between the author and a user should be mediated. You can write for more information to: Jan Abbott, Executive Director, Association of Shareware Professionals, 545 Grover Rd., Muskegon, MI 49442.

If you belong to PC MagNet, you can download the ASP information packet from the Utilities forum data library number 8 (ASP Application); it's a file called APPLIC.FRM (see page 8 for details on joining PC MagNet). On CompuServe, you can get the file from the ASP's forum called Shareware. Even if you don't plan on joining the ASP, you should get a copy of their Shareware standards to follow in distributing your game.

COPROCESSORS AND GUIs

Would a coprocessor be useful in running an operating system that includes *Adobe Type Manager* or TrueType? Does the addition of a font library or the growth of GUIs make a coprocessor useful even when the application doesn't need it to run?

Would a user of a 16- or 20-MHz 386 gain useful speed with a coprocessor, given a bulky operating system like OS/2 or *Windows*?

Brian B. Mulholland
Port Jefferson Station,
New York

From the way your question is worded, I assume you're asking about a math coprocessor. The simple answer is a qualified *no*. The current GUIs (graphical user interfaces) that run on PCs use integer math functions for their drawing routines, so installing a math coprocessor, which speeds floating-point calculations, wouldn't improve the speed of the fonts being created and drawn on the screen.

Font packages such as *Adobe Type Manager* (Adobe Systems Inc., Mountain View, Calif.; 800-833-6687, 415-961-4400; $99) and *FaceLift* (Bitstream Inc., Cambridge, Mass.; 800-522-FONT, 617-497-6222; $99) generate fonts on the fly using processor cycles, so a faster CPU is the only thing that would make a difference in display speed.

I say the *no* is qualified, because there is a place where a math coprocessor helps: when the bitmaps for downloadable fonts need to be generated. If you use one of the programs that require

several minutes to create font outlines stored as disk files (such as Bitstream's *Fontware Installation Kit*), a math coprocessor will cut the font-generation time to about half. After those fonts are generated, though, the math coprocessor won't help.

TrueType, which will be the font generation engine for *Windows* 3.1 when it's introduced later this year, probably will not use floating-point math either, though it's too early to say for sure.

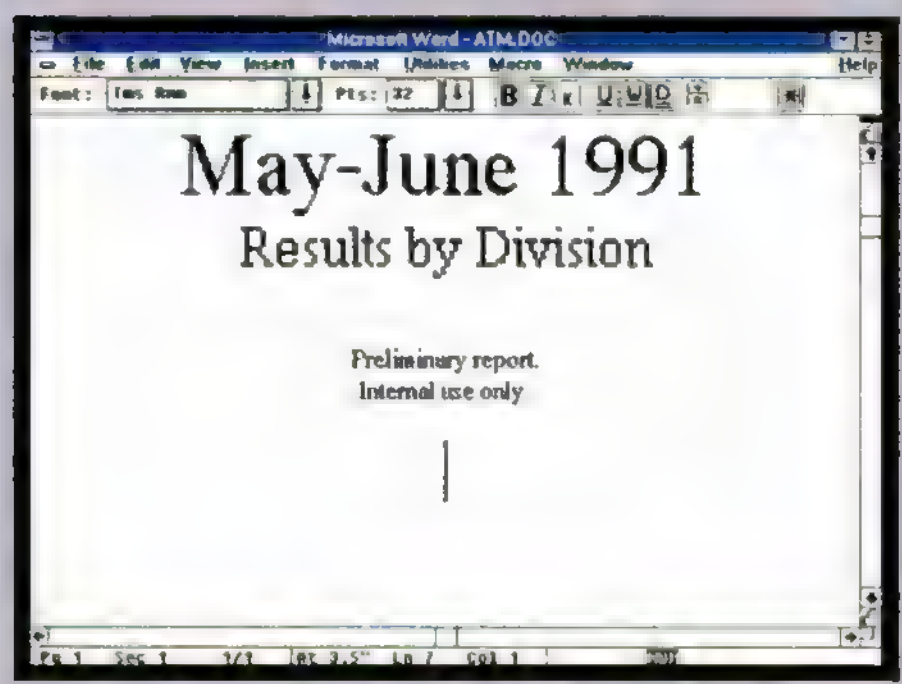
However, there is another type of coprocessor that improves the screen speed of GUI systems—a graphics coprocessor. Video boards based on graphics chips such as the Texas Instruments TIGA-340 series or the Intel i960 make a dramatic improvement in display redrawing and speed. The down side is that such boards are not cheap (averaging over $1,000 list price), so they're not a solution for everyone; they're marketed for people who do heavy design work.

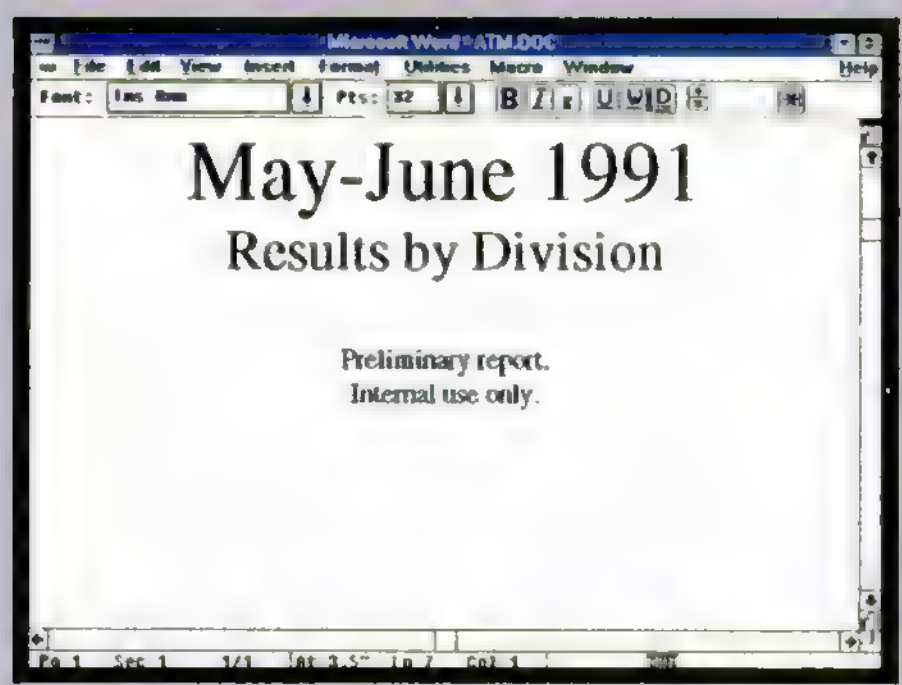
If you're interested in buying a graphics board with a coprocessor, you may want to wait a few more weeks. In the July 1991 issue, we'll be publishing the results of testing on coprocessed boards that is going on in PC Magazine Labs as I write this. The most recently introduced high-resolution 8514-compatible boards from ATI, Paradise, and Hewlett-Packard will be included.

Another alternative is IBM's new XGA video display, though it's not yet available for any systems other than IBM's high-end PS/2s. XGA has proprietary IBM logic for faster bit-blitting, which helps considerably when drawing fonts and windows.

Unfortunately, there's no simple answer on the best way to improve video performance with *Windows* and OS/2. You should read the story about comparative tests we performed in PC Labs ("Boosting Video Performance Under Windows 3.0," February 26, 1991).

One finding was that newer video drivers for a particular board can make a dramatic improvement. New drivers are often posted on Microsoft's Windows forum on CompuServe.





Adobe Type Manager **can make a dramatic improvement in the appearance of a font. Figure 1, top, shows characters displayed in the roman typeface that is included with *Microsoft Windows* when installed for a LaserJet II; the characters approximate the smooth fonts that will be downloaded to the printer. In Figure 2, bottom, the larger characters have smooth edges, thanks to *Adobe Type Manager*.**

PRN AND OTHER GHOSTLY FILENAMES

In preparing a graphics image of a printer, I casually named the file "PRN." Since PRN is a device name, this caused my system to hang.

Then unusual things started happening. A PRN ghost file was created that now appears in every directory (including new directories). This ghost file always maintains the current date and time, and rejects all DOS commands. The PRN files appear only when a file search (filespec: PRN.*) is performed from programs such as *The Norton Commander*, *WordPerfect*, or *Windows* File Manager.

Can you shed light on this situation? Is this a harmless ghost?

Karl L. Schwartz
Staten Island, New York

Don't worry, the PRN ghost haunts every DOS machine; the only reason you never noticed it before is that you never looked for it. Those PRN listings you see are not the file you created, they are the DOS device name for a printer. Your graphics image file disappeared into the other world when you rebooted as DOS searched for an active printer.

The reason your computer hung when you tried to name the file "PRN" is that it was trying to copy the file to the PRN device (which defaults to LPT1), and there was no printer there to receive it.

DOS would have eventually timed out and reported that the printer wasn't ready. The time it takes to do this varies depending on the version of DOS and the machine's BIOS.

PRN is reserved by DOS to be the name of a device, just like AUX, CON, NUL, and the various parallel and serial ports. When you ask for a file, DOS searches its list of device names first for a match. DOS's DIR command doesn't display these internal devices, but many other programs, including the three you mentioned, will.

There is only one copy of the list, though, so the device names aren't really taking up space everywhere on your disk.

You can use these ghostly files to your advantage, though. User-to-User author Neil Rubenking says the fact that a DOS device is always present can be used to assume a guaranteed "yes" answer in a logical query.

Let's say you want to determine if a particular subdirectory exists before you take any action on it. You can, for example, create a batch file that contains this line:

```
IF EXIST \FOO\PRN COPY A:*.*
\FOO
```

Because DOS searches for the names of the devices first, the condition you're testing for (the existence of PRN in the FOO subdirectory) will only be true if the subdirectory exists.

For a deeper understanding of how DOS works, keep an eye out for the forthcoming book *PC Magazine DOS Techniques and Utilities* by Jeff Prosise (the author of *PC Magazine*'s Tutor column) from ZD Press (Berkeley, Calif.; ISDN 1-56276-007-6; $39.95).

ASK THE ADVISOR

Send your questions to PC Advisor, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the instructions for joining on page 8 of this issue). Sorry, but we cannot send personal replies. ■

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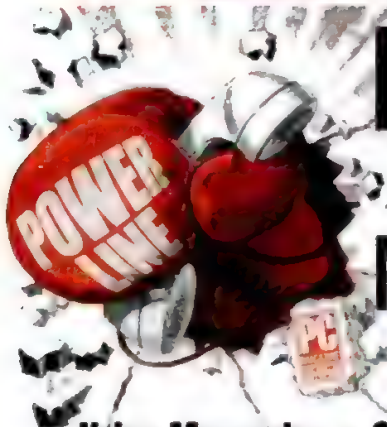

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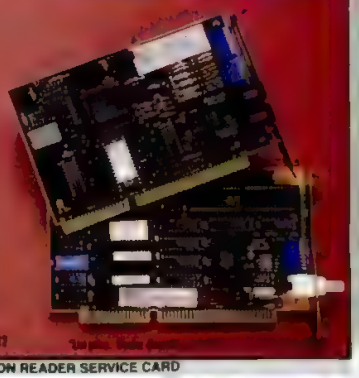

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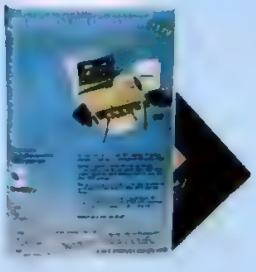

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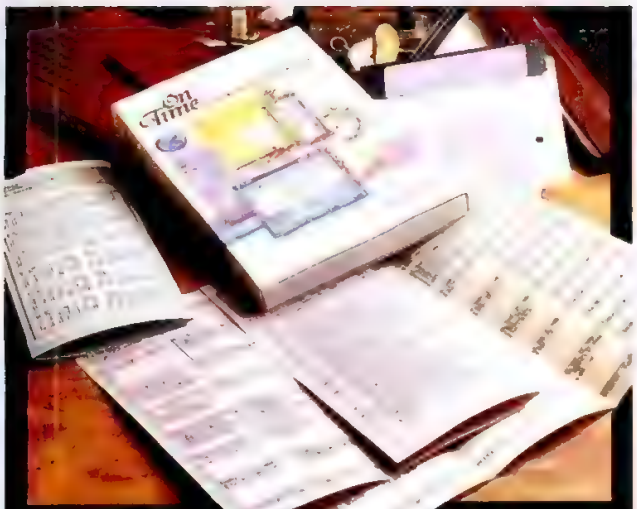

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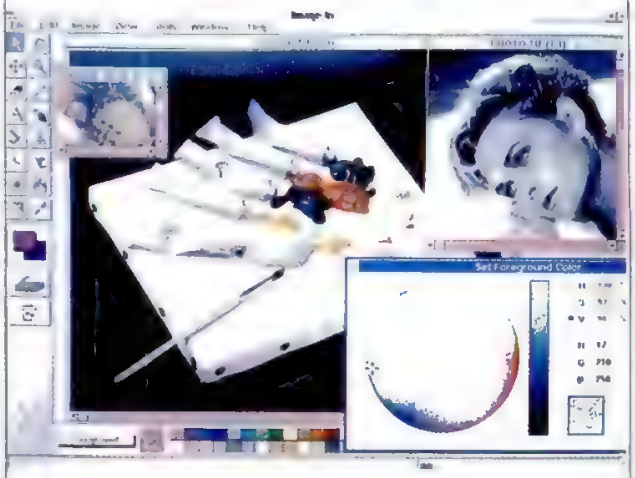

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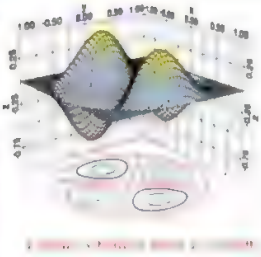

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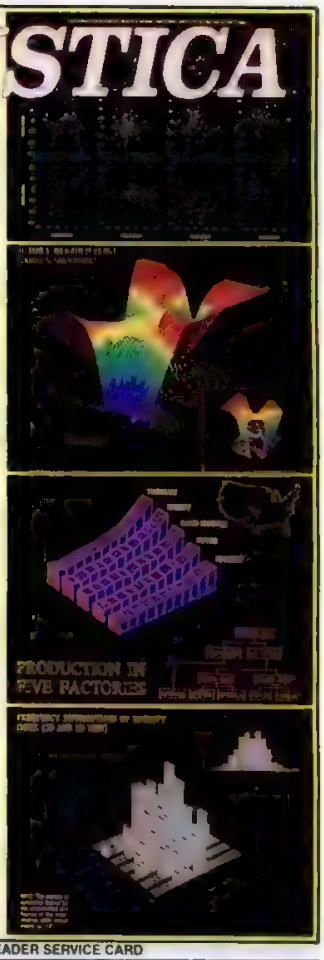

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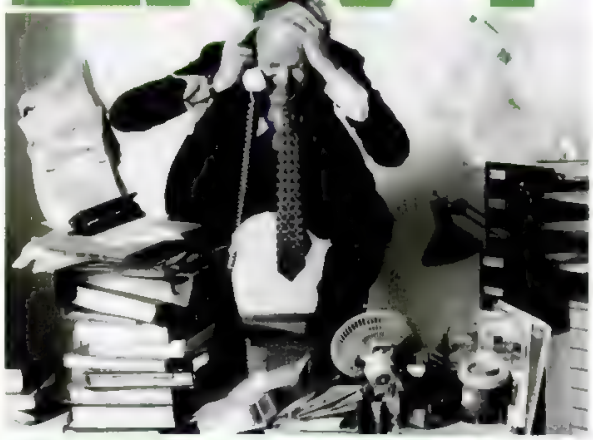

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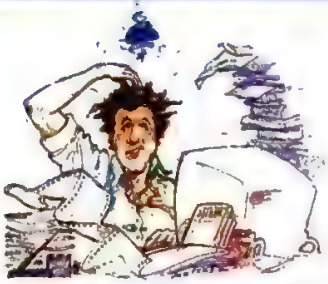

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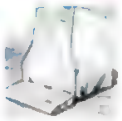

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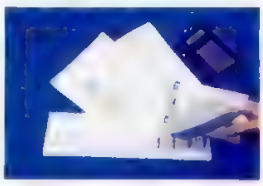

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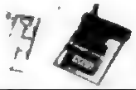

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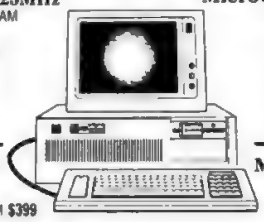

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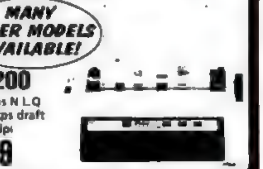

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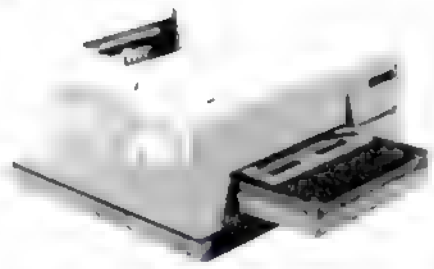

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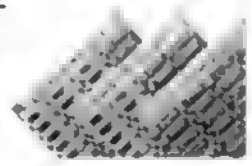

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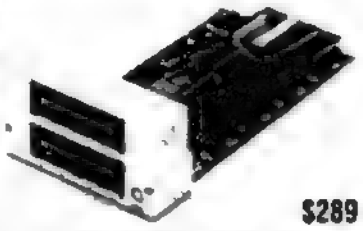

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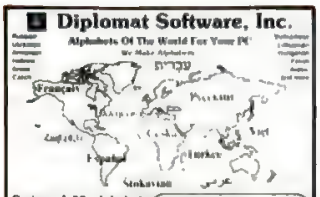

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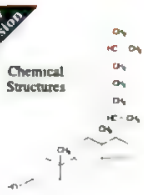

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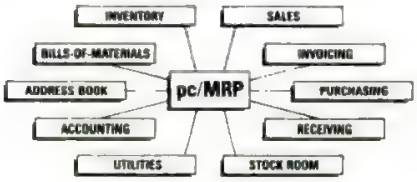

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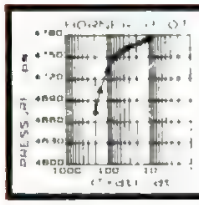

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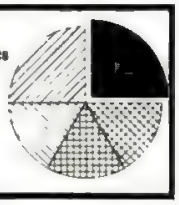

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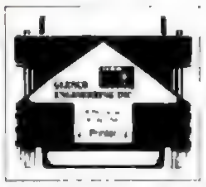

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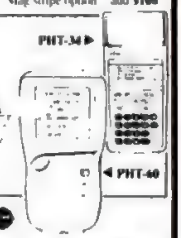

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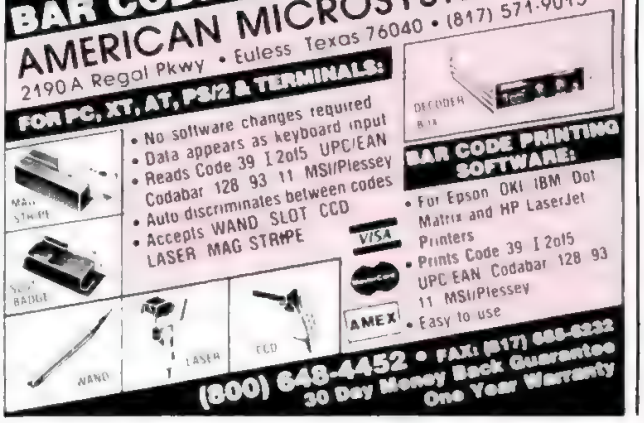

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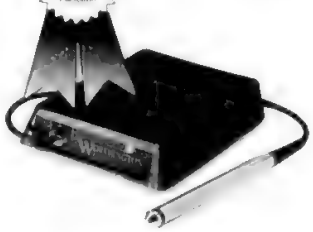

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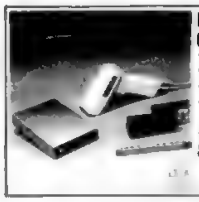

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PC Magazine is published 22 times a year, (bimonthly except for July and August). The BusinessCard closing is approximately two months prior to issue date.
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COMING UP

■ 25-MHz 486 PCs

The outlook for 25-MHz 486 PCs keeps getting better: Now it's easier to find one of these systems for less than $5,000. At an average increase of 10 to 15 percent over 386/33s and about a 25 percent premium, the extra power is just about worth the price. In the second of a two-part series, PC Magazine Labs tests 33 new EISA, ISA, and MCA 486/25s.

■ ILLUSTRATION SOFTWARE

Our graphics experts take another look at four mainstays of this perennial category. Most of these programs have been substantially revamped since our last visit, plus you'll get to see what performance benefits are accrued from *Windows* 3.0.

■ DOS-BASED LANs

DOS-based LANs aren't just for installations of 10 or 12 PCs: The best products challenge Novell's *NetWare* 2.1*x* by handling hundreds of PCs at top speeds. PC Labs reviews 13 products that use LAN adapters supporting the 10-megabit-per-second Ethernet, IEEE 802.5 Token-Ring, and/or ARCnet industry standards.

■ COPROCESSED 1024 DISPLAY ADAPTERS

When it comes to putting together a high-resolution display system, choosing the right graphics adapter is crucial. For the ultimate performance under *Microsoft Windows* and *AutoCAD*, coprocessed video boards are your best bet today. *PC Magazine* examines 15 adapters, priced from $600 to $3,000, that support noninterlaced 1,024-by-768 resolution.

■ ARC TANGENT MAILING LIST MANAGEMENT

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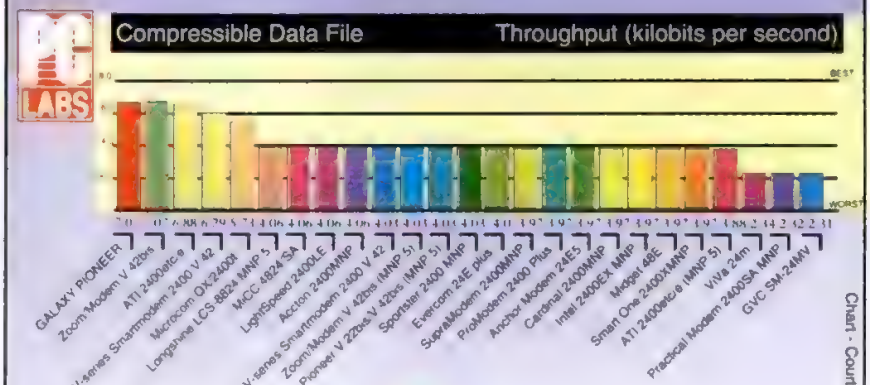

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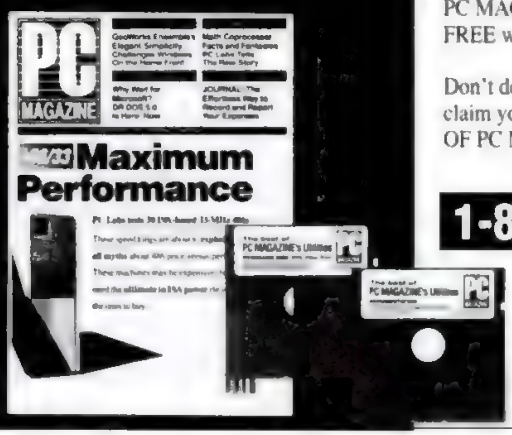

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After Hours

Products for the Leisure Side of Personal Computing

Finale Provides Powerful Desktop Music Publishing For a Reasonable Price

MUSIC
by Rob Kendall

When Coda Music Software recently ported *Finale* from the Macintosh to *Windows*, PC users gained access to the most powerful music notation package available for microcomputers. Version 2.0 for the PC incorporates all the features that previously were found only in the Mac implementation.

This $749 package is a true music publishing program, comparable in power and complexity with high-end desktop publishing software. It produces engraver-quality printed output of nearly any musical composition, and handles the notational conventions of popular music or large orchestral works with equal aplomb. Only the most experimental of composers is likely to be hindered by the program's few limitations. Like any powerful desktop publishing package, however, *Finale* requires you to invest some effort in mastering its many capabilities.

Once you learn the package, though, *Finale*'s musical intelligence saves you a great deal of time and frustration. Unlike some other notation software, *Finale* keeps your entire composition in one file. It won't let you fill a bar with the wrong number of beats, and automatically handles beaming, stem directions, and the positioning of marks such as staccato dots or fermatas. It rhythmically aligns the notes of simultaneous staves in piano or ensemble music, even if each staff is in a different meter.

While the quickest way to work is by scrolling your music in a single unbroken line from left to right, you can easily toggle to a page view that shows you exactly how the staves will be laid out on each page.

The simplest method for entering notes is to click on the appropriate note-duration icon and then click where you want to place the note on the staff. This can be rather slow for complex pieces, but an alternate approach lets you combine the cursor keys and number keys to place notes. With a little practice, this allows very fast note entry.

Once you've created your music, the program automatically optimizes not only the spacing of notes within measures but also the number of measures in each staff. It generally does a pretty good job with simple music, but for more complex pieces, you will probably need to respace some measures manually—which is a simple matter of dragging boxes that represent portions of the beat. The program then allows you to fine-tune your music, down to the position of every last accidental and the length of every note stem. The final step is adding titles, headers and footers, and annotations.

Finale's imposing array of toolbox icons supports a broad range of additional functions. You can concoct an oddball time signature, create nonstandard clefs and key signatures, or add expression markings from a customized library. Grace notes, complex tuplets, or tremolos are no problem, either. Jazz and pop musicians will appreciate the features for handling chord symbols, guitar fingering charts, and a wide range of percussion symbols. Orchestral composers can create a full score and then automatically extract the parts for each instrument from it. For early music, *Finale* accommodates figured basses, tablature, and some early vocal notations.

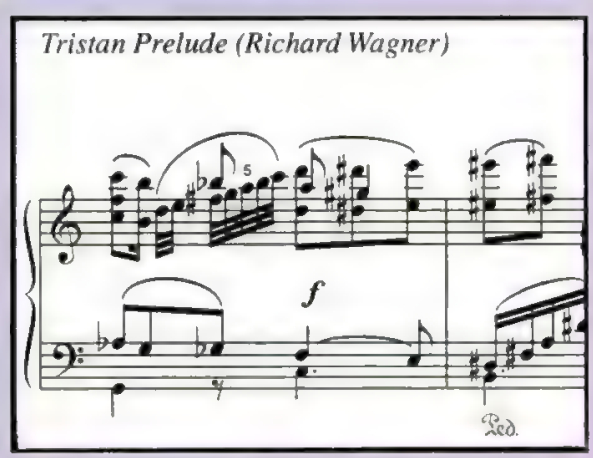
Creating vocal music couldn't be easier. You simply type in the lyrics, and each time you enter a space or a hyphen, *Finale* aligns the next word or syllable with the next note.

Contrapuntal music can be a big stumbling block for computer-generated notation, especially when several musical lines on the same staff must maintain notational independence. This is no problem for *Finale*, which lets you define up to four independent voices and keep stems oriented in the correct directions. For denser counterpoints, you can even superimpose multiple staves. My only real complaint is that accidentals and other elements in different voices tend to collide, requiring manual repositioning.

Finale is also one of the few notation packages that can deal with the ways that many modern composers stretch the conventions of Western musical notation. You can use just about any symbol as a note head, create splayed stems for note clusters, and alter note beams in all sorts of nonstandard ways. If all else fails to get your musical intentions across, a drawing tool lets you create your own symbols. There are only a few notational situations that *Finale* can't adequately handle, such as music with different staves in different meters with bar lines that don't line up vertically.

The package revises music just as adeptly as it creates it.

CONTINUES



This excerpt from a piano reduction of Wagner's opera *Tristan und Isolde* was produced on a LaserJet III with a PostScript cartridge.

■ MUSIC
Finale: A leap forward for desktop music publishing

■ GAMES
Tracon II adds a live link to *Flight Simulator*.

California Games II: Like, it's a sequel, dude

Finale

CONTINUED

You can cut and paste large sections or single chords and motives with ease; passages can be transposed just as simply and efficiently. When music is moved, any associated expression marks or lyrics move with it. There's even a search-and-replace function, though this still has a few bugs in it. The most remarkable editing feature permits intelligent copies of material; whenever you alter the original music, the copies you've made of it throughout the piece change accordingly.

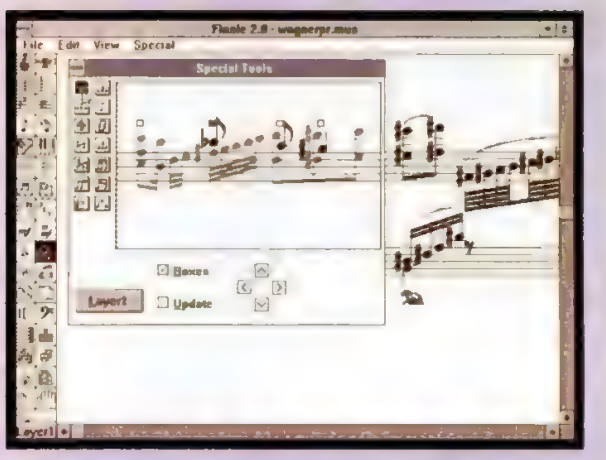
All this would be enough in itself to place *Finale* at the top of its class, but, as a bonus, you also get excellent integration with MIDI. *Finale* can import a standard MIDI file created on a sequencer and render it into notation. It can also transcribe a performance as you play. The results are quite accurate, though they usually require some touching up. *Finale* quantizes the music to eliminate the rhythmic fluctuations inherent in a musical performance.

Conversely, *Finale* will play back on a MIDI synthesizer any score you create—a boon for composers creating drafts or for copyists who want to do an aural proofread. It even respects first and second endings and tempo, dynamic, and articulation markings. You can also embed other sorts of MIDI data in the score or export the score as a MIDI file.

Finale is a challenge to learn, especially since it lacks any online help and relies heavily on cryptic icons. But once you've got it down, it's quick and intuitive to use. It is truly a software milestone that could eventually do for professional composers and arrangers what *PageMaker* and *Ventura Publisher* have done for writers and editors.

List Price: *Finale*, Version 2.0, $749. **Requires:** 286 or better processor, hard disk, 1.2MB or 720K floppy disk drive, 1MB RAM (2MB recommended), graphics display, DOS 3.0 or later, *Windows* 2.1 or later. Coda Music Software, 1401 E. 79th St., Bloomington, MN 55425-1126; 800-843-2066.

CIRCLE 601 ON READER SERVICE CARD



Finale lets you divide the notes on a staff into different voices and edit each independently.

SCORE: Notation Power at a Price

by Rob Kendall

When it was introduced four years ago by Passport Designs, *Score* ushered in the era of true desktop music publishing. It was the first microcomputer-based software that let musicians turn out engraver-quality printed music of any complexity from a laser printer. Today it remains the only program that can match *Finale* in output quality for large, intricate pieces of music.

Like *Finale*, it automatically optimizes the spacing of your music but allows manual control of individual elements. It handles all sorts of rhythmic complexities as well as the demands of orchestral writing, and can extract parts from a full score. For unconventional scores, it lets you customize elements in nonstandard ways.

Unfortunately, a number of factors have kept *Score* from entering the music software mainstream. One is its hefty price tag: $995 for *Score* alone or $1,400 with *ScoreInput* and *Escor*—companion programs that provide MIDI capabilities comparable (but not equal) with those of *Finale*. Another is its ruthlessly difficult interface, which never fully made the transition from the mainframe environment that spawned it.

The program relies on a confusing amalgam of a command line interface and function key menus, and requires you to enter musical material by typing it in as strings of ASCII characters. You enter pitches and rhythmic values separately, a system highly conducive to mistakes, and even medium-sized pieces must be stored in multiple files. *Score* isn't as intelligent about barring and beaming as it should be.

Editing is extremely cumbersome. Just cutting and pasting a few bars is a daunting procedure. You can click on individual notes to change stems, beams, or accidentals, but this requires negotiating an arcane system of numeric parameters. Poor documentation makes the program even more inaccessible. And when you're finally ready to print, you'll find support only for PostScript and a handful of dot matrix printers. ■

Would-be Air Traffic Controllers Can Link to MS Flight Simulator

GAMES by Don Trivette

In 1990, more than 43,000 people took the Federal Aviation Agency's test to get into the air traffic control academy in Oklahoma City, Oklahoma. Of that number, fewer than 2,300 were actually accepted and enrolled in courses at the academy. Only about 1,400 went on to the four years of field instruction it takes to finally become an air traffic controller. Although the pay is great, the dropout rate is horrendous, partly because many applicants don't understand what an air traffic controller really does, and partly because others find themselves temperamentally unsuited for the work.

Tracon II, from Wesson International, could help screen out the dilettantes from the true controller candidates. The original version of this simulation caused more sweaty palms than any horror movie, and gave users a really good taste of what life is like in the pressurized confines of the control tower.

The new version adds a much improved user interface, with mouse support and pull-down menus. The niftiest new feature allows a serial-port link to another PC running Microsoft's popular *Flight Simulator* (Version 3 or later). You can see and direct *Flight Simulator*'s planes on your *Tracon* radar scope, and the *FS* pilot can see the other aircraft in the surrounding air traffic control sector. A word of caution: It's almost impossible to be both pilot and controller and keep the blue side up.

Tracon II's main screen puts you at an air traffic control station, complete with a radar scope and flight strips showing active and pending aircraft like Boeing

CONTINUES

Tracon II

CONTINUED

727s, 747s, and smaller planes like Piper Cubs. The aircraft in your terminal radar approach control (TRACON) fall into one of three groups: overflights, departures, or arrivals.

Overflights are the easiest to handle, since they are planes passing through at a high altitude, and require little involvement from you unless there are conflicts with other aircraft. Departures are also relatively easy, requiring that you first give approval to the tower for the flight to take off, and then verify that the pilot stays on an approved outbound course. Problems arise when several aircraft want to depart at the same time, forcing you either to hold some of the flights or to reroute the outbound planes.

Arrivals separate the controllers from the wannabes. After accepting an arrival handoff from another control center, you have to guide the flight to the airport approach. You do this by giving timely instructions to the pilot about altitude and headings. Communication with *Tracon* aircraft is via keyboard instructions consisting of an aircraft ID, a command, and parameters. A typical command might say "N123DV climb and maintain 6,000 feet."

The software has enough features and options to keep the most jaded aviation buff happy. You can set parameters for weather (clear to stormy), pilot skill (perfect to lousy), and emergencies (none to nightmare). If life's gotten a little dull, select stormy weather, a lousy pilot, and nightmare emergencies and watch your scope light up. There is even an audio cassette that synchronizes with a 10-minute demonstration.

Traffic control sectors for San Francisco, Los Angeles, Chicago, Boston, Seattle, and Miami are part of the package; for $40 you can purchase disks covering 24 additional cities. Other optional equipment includes a $350 voice recognition system that lets you "talk" to the cockpit, and a $60 speech box with digitized voice disks that lets you "hear" the pilot.

Tracon is complex and detailed, although real controllers will note many simplifications and, no doubt with some glee, that the radar blips are shaped like tiny airplanes. Nevertheless, it'll take weeks to master the basics and perhaps months to become really proficient; but that's the whole point. If you're considering a career in ATC, or if you're a pilot who wants to check out the other side of aviation, try *Tracon*. It's guaranteed to leave you with moist palms and a pumping heart.

List Price: *Tracon II*, $69.95 ($29.95 as an upgrade to *Tracon I*). **Requires:** 512K RAM, graphics adapter, DOS 2.0 or later. Wesson International, 500 South Capital of Texas Hwy., Austin, TX 78746; 800-634-9808.

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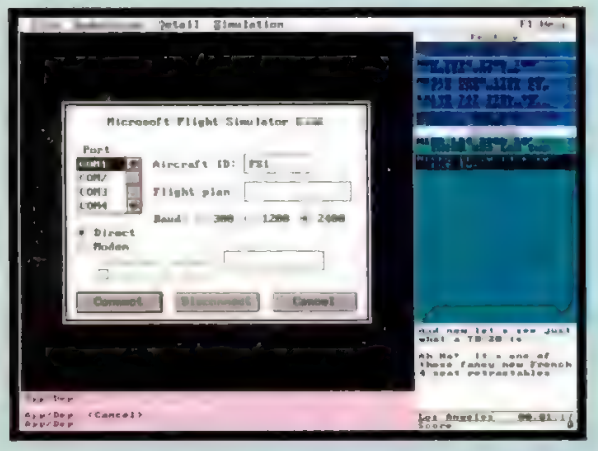

One of the best new features in *Tracon II* is the ability to link up to another PC running *MS Flight Simulator*.

ENHANCING THE FANTASY: Add-on Scenery for Flight Simulator

by Don Trivette

Aircraft & Scenery Designer is a companion product for Version 4.0 of Microsoft's *Flight Simulator*, the software that puts you behind the stick of a Cessna Skylane, a Gates Learjet, or a Schweizer Sailplane. *A&S Designer* increases your fleet of planes, expands the changes you can make to an experimental aircraft, and lets you design you own scenery.

Some *FS* fans will cough up the $40 for this package just to get the four extra aircraft (which Microsoft should have included free in Version 4.0). Who can resist the temptation to fly Boeing's 747-400, billed as the world's most advanced commercial aircraft? Boeing engineers worked with Microsoft programmers to make the simulation so realistic that you must have an EGA (or better) monitor to display the instrument panel. The other new planes are a Beech Starship, a Piper Archer, and a generic seaplane.

Although *FS*, Version 4.0, lets you build experimental aircraft and specify some characteristics, *Aircraft & Scenery Designer* gives you control over more parameters, including thrust, weight, canard control, damping, hysteresis, lift, and drag. You can also select flaps, spoilers, and thrust reversers. It takes an aeronautical engineer to appreciate the effects of these parameters. The scenery-design portion of the software is easier to understand and use. With it you can create and modify objects like roads, bridges, buildings, and runways. Moving scenery like cars, trucks, and boats can also be added. With time and effort, you can model your hometown airport and even your own house.

Aircraft & Scenery Designer is a must for aviation buffs, but a little too expensive and technical for those who just want to buzz the tower on occasion. ■

***A & S Designer* adds new planes to those that come with *Flight Simulator*.**

Epyx Unveils Gnarly Successor to California Games Arcade Package

GAMES by Don Trivette

Hey, cool Dude, it's time for the second installment of gnarly action from Epyx software. *California Games II* features five new laid-back sports that will challenge your finger muscles and keep your mind from turning into organic granola.

First, there's hang gliding. You get two minutes of thermal updrafts to show your stuff. Swoop, loop, and stall to your heart's content, but remember to keep an eye on the clock. Each maneuver carries points, and extra points are awarded for

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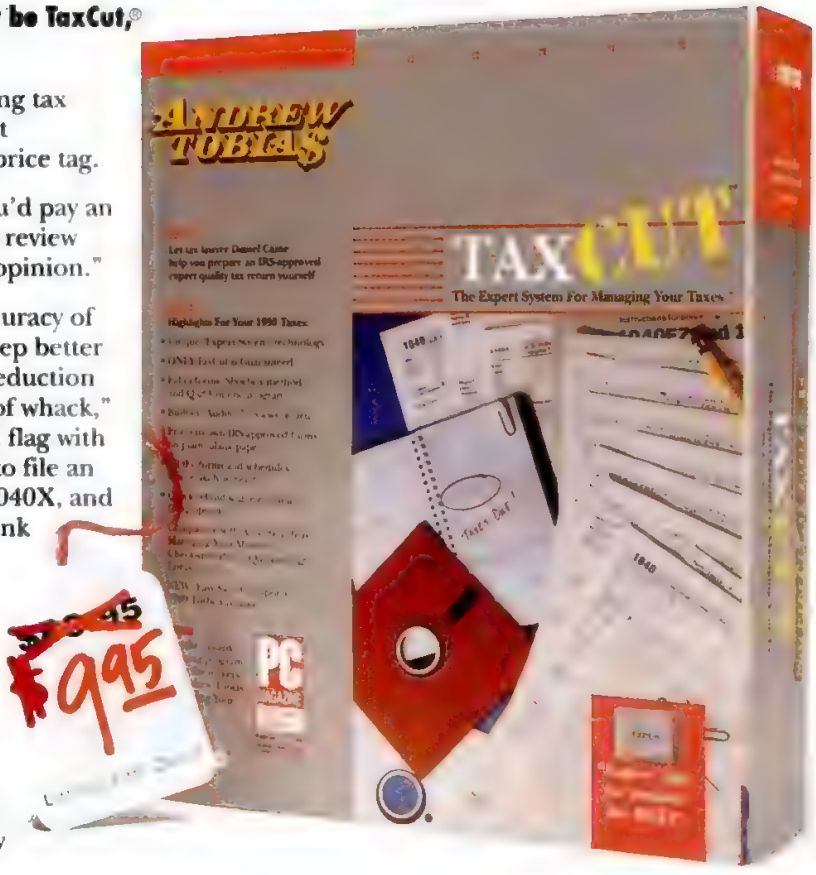

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California Games II

CONTINUED

dropping water balloons on target. It's fun, but it ain't exactly *Flight Simulator*.

Jet surfing, the second event, takes place on an ocean course marked with buoys. Extra points are earned for feats like ramp jumping and for snagging the occasional bottle, but time is by far the most important factor in winning this event, so don't play ecology Eddie if a bottle is too far off the course.

The third event is snowboarding down Mt. Epyx on one of three courses. The better your time, the higher your score; bonus points are earned for funky stuff like handplants, edge rides, and loops. This is skateboarding for snow bunnies.

Bodyboarding is the fourth event; you score points for spinning, cutting, and various off-the-lip maneuvers. Bodyboarding is a lot like the excellent surfing that made the original *California Games* a smash hit—but let's face it Buds, bodyboarding isn't surfing.

The final event rescues *CGII* from oblivion. The outlaw skateboarding course may even be good enough to justify the price of the software—especially if you are a dedicated thrasher. As you half-pipe and full-pipe your way along a giant aqueduct and drainage system, you never know when the next turn may mean a faceplant into a concrete abutment. Skateboarding is the mega challenge of *CGII*.

If you surfed *California Games I* 'till you had callouses on your fingers, you might get amped by *CGII*. On the other hand, I was disappointed in the relatively few technical improvements in the Epyx gaming system. Graphics, for example, are mostly the 16-color variety, although the title screen and some snowboarding shots are displayed as 256-color VGA. Support for sound cards is minimal and costs extra and there's no mouse support. Get with it, most excellent programming Dudes, and give us something new. (Incidentally, Epyx is considering an all-surfing game; if hanging ten on your PC appeals to you, then write and tell them.) ■

The skateboarding event provides the greatest challenge in *California Games II*, from Epyx software.

List Price: *California Games II*, $49.95. **Requires**: 512K RAM, graphics adapter, DOS 3.2 or later. AdLib sound upgrade available for $10. Epyx Inc., P.O. Box 8020, Redwood City, CA 94063; 415-368-3200.

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by Bill Howard

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—San Francisco Examiner & Chronicle, December 16, 1990

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—Calgary Bargain Finder, October 18, 1990

CARTOON: RICHARD TENNANT

Intel chairman Andrew Grove on the use of electronic mail services such as CompuServe and Prodigy by families sendng messages to U.S. troops in the Persian Gulf:

"The military particularly liked Prodigy because the censorship came for free."

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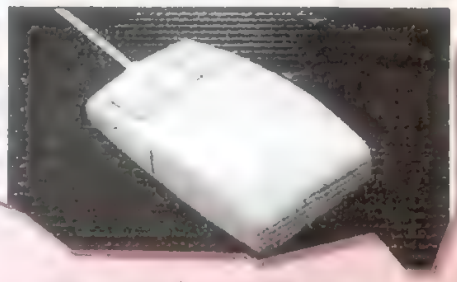

This Damark ad in PC Week says it's a cordless mouse.

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a PC Magazine T-shirt. Winners this issue: Trevor Russ (Terrible Editor), Gary Muzzarelli (right-center-left), Glenn S. Hansen (cordless mouse), John Schmidt (free consolation), Anthony Watts (microwave Windows).

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